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MYCOTAXON

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CONTRIBUTION TO OUR KNOWLEDGE OF THE APHYLLOPHORALES (BASIDIOMYCOTINA) OF THE BASQUE COUNTRY.II*

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Summary

Four species until the present unknown in the Iberian mycological flora are mentioned and described, namely: *Acanthobasidium phragmitis* Boidin & al., *Auriporia aurulenta* A.David & al., *Flaviporus brownei* (Humb.) Donk and *Sarcodontia crocea* (Schwein.:Fr.) Kotl.

Resúmen

Se citan y comentan 4 especies no conocidas hasta ahora para la flora micológica ibérica, a saber: *Acanthobasidium phragmitis* Boidin & al., *Auriporia aurulenta* A.David & al., *Flaviporus brownei* (Humb.) Donk y *Sarcodontia crocea* (Schwein.:Fr.) Kotl.

INTRODUCTION

Following work started a few years ago, which has the final aim of cataloguing the Basque Country's Aphyllophorales, different phases corresponding to the sampling of concrete areas have been covered (cf. Salcedo Larralde, 1989; Salcedo & Tellería, 1992). During the sampling done, the above mentioned species have turned out to be interesting, whose appearance might have been favoured by the climatology of 1992.

The samples studied are in the Herbarium of the University of the Basque Country (BIO), or in V. Martínez's private Herbarium (VM).

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* Work supported by the University of the Basque Country (UPV/EHU) project n° 118.310-E191/91

Acanthobasidium phragmitis Boidin & al. Bull. Soc. Mycol. France 101(4):345. (1985)

VIZCAYA: Lejona, barrio deTellería, 30TWP0098, 50 m, on *Arundo donax*, 12-XI-1992, I. Salcedo, 6275IS, BIO-Fungi 4693; *ídem*, 6278IS, BIO-Fungi 4692.

In 1985 Boidin & al. described this species, that forms little menbranous and whitish patches, on stems of two genera of the Poaceae family. The specimens studied have also been collected in this same family and relatively near from the described area.
The microscopic characters are very gaudy, having pleuroacanthobasidioles with numerous apical protuberances (figs. 1A,3A), also gloeocystidia with a round jutting apex and which are sometimes rather moniliformic (figs. 1C,3B), about 20-24 x 8-10 *µ*m. Basidia have four sterigmata and with many visible protuberances on the lower middle part, which differentiates it from *A. norvegicum* (J.Eriksson & Ryvarden) Boidin & al., since its basidia have two sterigmata and very few protuberances (l.c.).
The basidiospores, that shrivel up and easily become deformed, are ellipsoid, very ornamented, and with long spines, easily seen in Melze's reagent, as they are strongly amyloid, and about 11-13 x 6.5-8 *µ*m (figs. 1D,3C,3D).

Auriporia aurulenta A.David & al. Bull. Soc. Mycol. France 90(4):359-370 (1974)

ALAVA: Valdegovía, Nograro, 30TVN9040, 950 m, on *Pinus sylvestris*, 30-V-1992, J.L.García, L.Manso, V.Martínez, X. Olano & I. Salcedo, 7561VM; *ídem*, 5629IS, BIO-Fungi 4690.
GUIPUZCOA: Aya, Laurgain, 30TWN6787, 450 m, on *Pseudotsuga menziesii*, 21-XI-1992, J.L. Albizu, J. Huarte, X. Laskibar, J.M. Lekuona & I. Salcedo, 6336IS, BIO-Fungi 4696.

This species is easily recognized in the field by its basidiocarp resupinate with hymenophore poroid, deep yellow-orange in colour, but turning ochre with age.
Its microscopy is distinguished by its monomitic hyphal system, hyphae with clamps, its cystidia stalks and ventricose, more or less fusiform, thick-walled, and about 20-35 x 8-12 *µ*m, with grainy crystals on top (figs. 2A,3F) and by the presence of hyaline and lageniformic leptocystidia, 60-70 x 5-10 *µ*m (figs. 2B,3F). The basidiospores are ellipsoid and, in the specimens studied, about 4.5-6 x 2-3 *µ*m (figs. 2C,3I,3J).

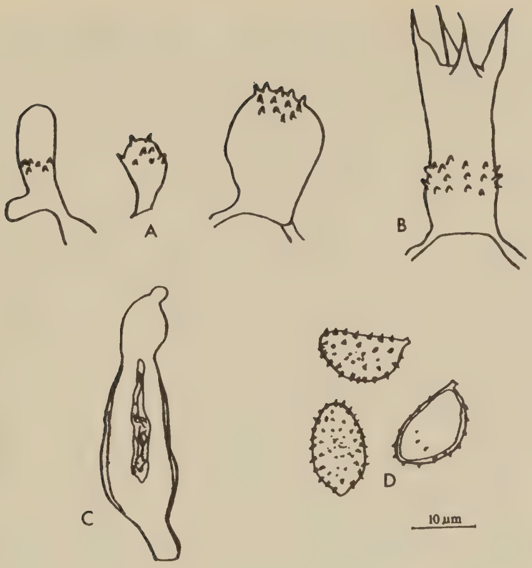


Fig. 1.- *Acanthobasidium phragmitis*, BIO-Fungi 4693. A. pleuroacanthobasidioles. B. basidium. C. gloeocystidium. D. spores.

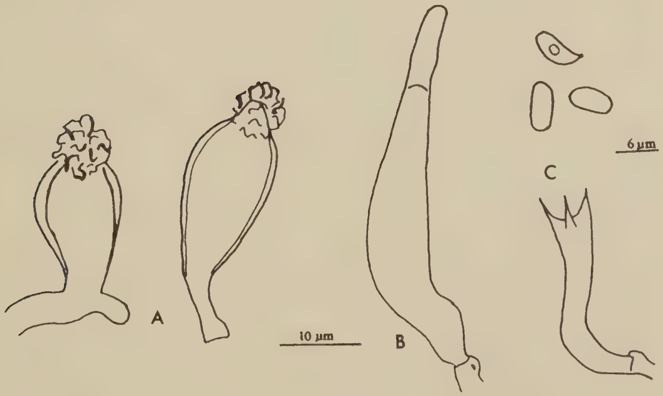


Fig. 2.- *Auriporia aurulenta*, BIO-Fungi 4690. A. Cystidia with crystals on top. B. leptocystidium. C. basidium and spores.

This species is known in Europa from Austria, Czechoslovakia, France, and the one time Yugoslavia (*cf.* Jülich 1984:335).

Flaviporus brownei (Humb.) Donk Persoonia 1: 189 (1960)

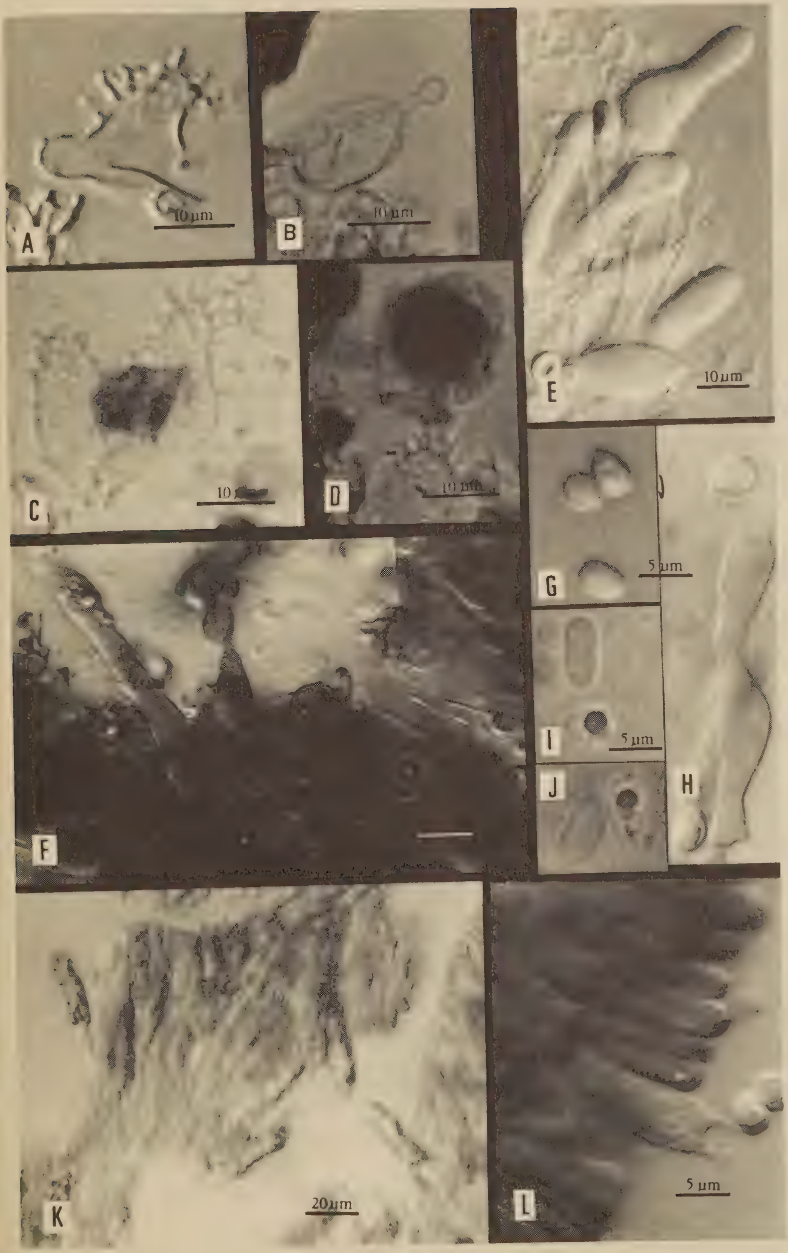
GUIPUZCOA: Oiartzun, Arizabalo, 100 m, 30TWN9295, on *Pinus* sp. very wet, 26-IX-1992, I. Salcedo, 5890IS, BIO-Fungi 3821. Aya, Laurgain, 30TWN6787, 450 m, on *Larix* sp., 21-XI-1992, J.L. Albizu, J. Huarte, X. Laskibar, J.M. Lekuona & I. Salcedo, 6374IS, BIO-Fungi 4694. Aya, Altxerri stream, 180 m, 30TWN6888, on wood very wet, 21-XI-1992, J.L. Albizu, J. Huarte, X. Laskibar, J.M. Lekuona & I. Salcedo, 6420IS, BIO-Fungi 4695.

A species which is mainly found in tropical areas; until now it was only to be found in Europe in greenhouses and mines (cf. Ginns, 1980:1581; Ryvarden & Gilbertson, 1993:253). The specimens studied grow in open places (out of doors), which are always very humid. We will add that, in 1992, the species has also been found in Bayonne (France) by David & al. (pers. com.).

The sulphur-yellow colour of the basidiocarp and the hymenophore poroid with 9-10 pores per mm makes the identification of the species in the field easy.

The species is also usually easy to recognize because of the presence of numerous cilindric, long cystidia, thickly walled and strongly encrusted in the upper part, embedded in the trama or projecting slightly above it (fig. 3K); also by the ellipsoid basidiospores, about 2.5-3 x 1.6-2 μm, since both are diagnostic characters of this taxon.

Fig. 3. A-*Acanthobasidium phragmitis*, BIO-Fungi 4693, pleuroacantho basidiole. B-Idem, gloeocystidia. C-Idem, pleuroacanthobasidioles and spores. D-Idem, shriveled and deformed spores. E-*Auriporia aurulenta*, BIO-Fungi4690, hymenium with cystidia. F-Idem, hymenium with cystidia. G,H-*Sarcodontia crocea,* BIO-Fungi 4691, spores and basidium. I,J-*Auriporia aurulenta*, BIO-Fungi 4690, spores. K-*Flaviporus brownei*, BIO-Fungi 4695, hymenium with cystidia. L-*Sarcodontia crocea*, BIO-Fungi 4691, hymenium.


A
10 µm
B
10 µm
E
10µm
C
10
D
10 µm
G
5 µm
I
5 µm
J
H
F
K
20µm
L
5 µm

Sarcodontia crocea (Schwein.:Fr.) Kotl. Ceska mykol. 7:117 (1953)
= *S. setosa* (Pers.) Donk

GUIPUZCOA: Hernialde, 250 m, 30TWN7478, on *Malus* sp., 25-X-1992, J. Huarte, 6269IS, BIO-Fungi 4691.

As indicated by Breitenbach & Kränzlin (1986:168) and Jülich (1984:171) this species is of a wide distribution but with a very concrete habitat as it usually grows on apple trees, especially old ones.
The resupinate basidiocarp, or stratified on vertical substata, hymenophore hydnoid with 5-7 mm long aculei, are the characteristics to be emphasized, as well as the sulphur-yellow colour and intensely nasty smell. When dried it loses some of its colour and smell .
The specimens studied agree with the description given by Eriksson & al. (1981:1275); nevertheless we underline the fact that its spores are subgloboses, smooth, with somewhat thickened walls, and usually with an oil-drop, and about 4.8-5 x 4 µm (figs. 3G,3H,3L).

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CONTRIBUTION TO THE LICHEN FLORA OF TRANSKEI

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Bag XI, Umtata, Transkei, South Africa

ABSTRACT

Fourteen species of lichens which have been discovered as new to Transkei, are described. The result of the recent investigations are based on the collections made from nine districts of this region. The physical selective forces limit the period of acquisition of resources needed for the growth. Frequent changes in the elements of climate, such as unexpected cold wave, irrespective of the season are contributing factors to the relatively small number of species. Lichen flora of Transkei have been unexplored for a long time. Interesting and new species are expected from this region. No lichen community is reported as endangered. Changes in the lichen flora cannot be assessed, as there is no previous comprehensive record of lichens in Transkei.

INTRODUCTION

Lichenological exploration of the Transkei region started in 1953. Collections made by Almborn from Port St. Johns and Flagstaff were the first, to reveal the existence of interesting endemic taxa and ubiquitous species in this area (Almborn 1966). Distinct foliicolous Lichen specimens from Dwesa Nature Reserve are illustrated by Brusse (1992). The present account is a contribution to the lichenological exploration of Transkei. In all, 500 collections were made belonging to 115 species. Some of them have been identified and others are under the process of identification. The identified specimens are new records for the Transkei region and described in this paper. In spite of all previous investigations many and interesting parts of Transkei remain unexplored as far as the lichen flora is concerned. Among the species recorded as new for Transkei come under fruticose 5 and foliose 9.

MATERIALS AND METHODS

The following account is based on the collections made by the authors in 1992 from nine districts of Transkei, South Africa. The materials are placed in the authors herbarium and the representative set deposited in the herbarium of the University of Transkei (KEI) for future reference. The following number codes are used to indicate the collecting localities and their altitudes.

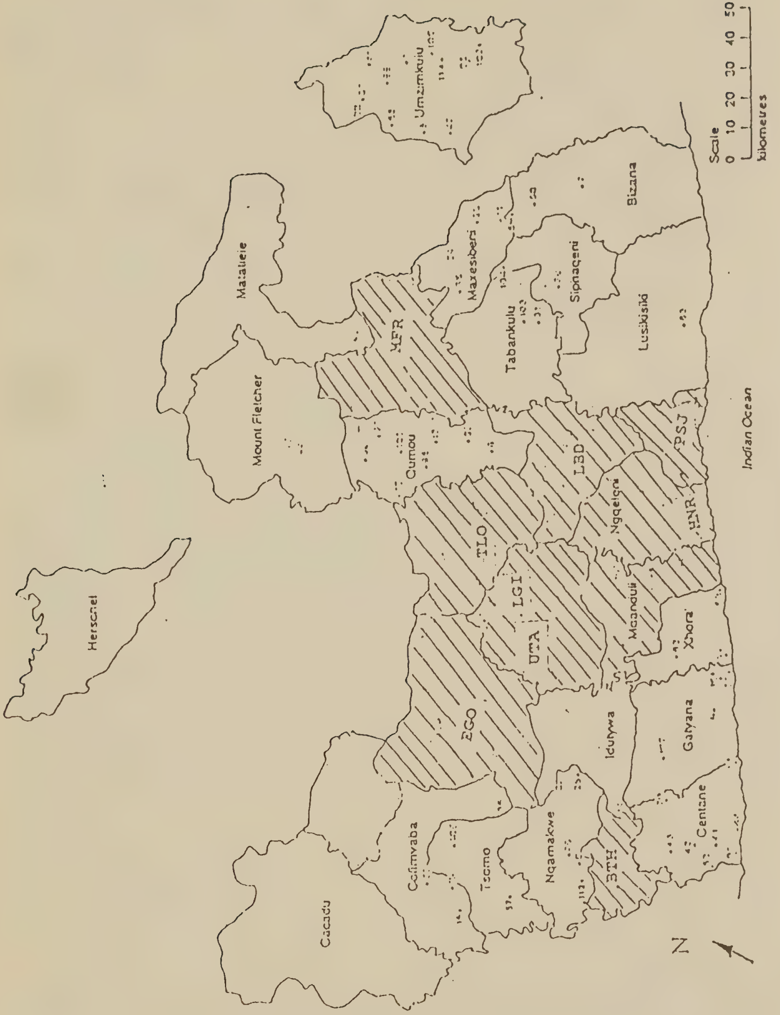
Port St Johns PSJ 1	5-25 M
Hululeka Nature Reserve HNR 2	200 M
Libode LBD 3	930 M
Butterworth BTH 4	680 M
Encgobo EGO 5	1200 M
Langeni LGI 6	900 M
Tsolo TLO 7	1300 M
Mt. Frere MFR 8	1200 M
Umtata UTA 9	800 M

The specimens were collected from different localities (see map of Transkei), dried and preserved by customary method. Visits to the localities were made at different seasons. Morphology of the upper and the lower surfaces of the thallus, rhizine occurrence and the fruiting bodies were examined for identifications. Macrophotographs were taken with a cannon camera using close up view lens X 6.

ECOLOGY

Growth of most lichens is controlled by specific requirements like moisture, light and temperature. These factors together with altitude effectively restrict their distribution. The physical selective forces limit the period of acquisition of resources needed for growth.

Transkei is between 27°-30° E longitude and 30°-33° S latitude, has an area of 58024 Ha. The ecologic - geographic variations are from coastal region hilly midland to mountainous interior with sub tropical climate with hot wet summer and warm dry winter. The interior is similar to coast but cooler with increasing height. The average daily minimum temperature of the coldest month (July) is 7° c and average daily maximum temperature of hottest month (January) is 28° c. Average rainfall in summer season is 600 mm. although it varies greatly from place to place. Average rain fall in winter is 200 mm. Towards the end of the winter season, this peninsular region experiences strong gale blowing from south polar region. Relative humidity is approximately 40% in the interior and it varies from 60% - 70% at the coast and midland. The altitude varies from sea level to 2000 m. Habitat ranges from dry mountainous area, grass topped bare hills, humid forests and wild coast supporting varied lichen flora.


Herschel
Matatiele
Mount Fletcher
Umzimkulu
Bizana
Maxesibeni
Tabankulu
Sipnaqeni
Lusikisiki
MFR
Qumbu
LBD
PSJ
TLO
Ngqeleni
MNR
LGI
UTA
Mqanduli
Xhora
EGO
Idutywa
Gatyana
Centane
Cofimvaba
Tsomo
Nqamakwe
STH
Cacadu
Indian Ocean
Scale
0 10 20 30 40 50
kilometres
N

Map of Transkei

Description of the species are based exclusively on materials studied by the authors. Many taxonomically or phytogeographically poorly investigated species, are not included in the list for the time being. The following collector's abbreviation is used (R.B.B - R.B. Bhat) for the specimens.

R.B.B. 101. Parmelia(Rimelia)reticulata Tyl.
Corticolous, foliose, upper surface of the thallus is green, lower surface brown along the tip and black towards the other regions. Apothecia not very common. Densely rhizinate on its lower surface. Width of the thallus 8-10 mm. It is commonly found in Umtata.

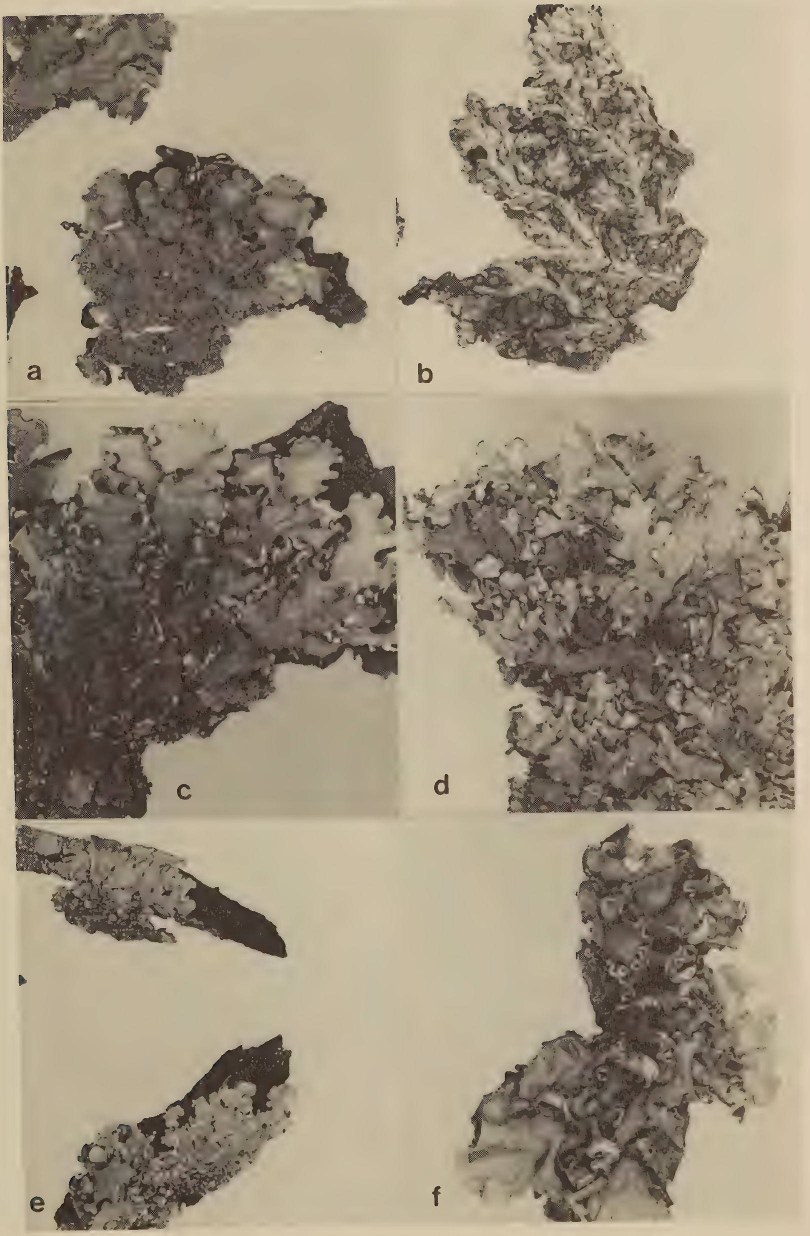
R.B.B. 102. Xanthoria parietina (L.) Th. Fr.
Corticolous. This is a bright orange red foliose species. Thallus turns green when it is wet. Sparsely rhizinate on appressed parts of the thallus. Round apothecia is sessile and adnate. Apothecial discs are orange red in colour. Grows on the fresh bark of the shady trees along Umtata river bank behind St.Bed's College. It prefers shady places with high humidity at 400 m - 600 m MSL. Width of the thallus 3-4 mm. It is a rare species.

R.B.B 103. Parmelia(Flavoparmelia)soredians Nyl.
Corticolous, foliose, upper surface of the thallus yellowish green, lower surface black, moderately rhizinate on appressed parts of the thallus. It is commonly found on the fresh bark of maple trees near stadium of the Transkei university campus Umtata. Width of the thallus 2-5 mm. Apothecia not common.

R.B.B. 104. Parmelia(Punctelia)borreri (Sm.) Krog.
Corticolous, foliose, upper surface of the thallus is green lower surface is brown and black. Short rhizines occur. Found on dry/fresh bark of shady trees along the bank of Umtata river on the lower side of St. Bedes College. Width of the thallus 5-7 mm.

R.B.B. 105. Dirinaria picata (Sw.) Aem. & Shear
Corticolous, foliose, upper surface of the thallus is grey, lower surface black. Thallus firmly attached to the substratum. Grows on dry bark of the trees along the bank of Umtata river. 5-6 cm in diameter. Width of thallus 2-4 mm.

Plate 1- General aspects of Parmelia and Heterodermia spps., showing different forms of lobes and apices.
a- Parmelia (Punctilia) borreri b- Heterodermia diademata c- Parmelia(Rimelia)reticulata d- Parmelia(Xanthoparmelia) mutabilis e- Parmelia(Flavoparmelia)soredians f- Parmelia (Parmotrema) austrosinensis Magnification x 1


a
b
c
d
e
f

R.B.B. 106. Heterodermia diademata (Tayl.) Awasthi
Corticolous, foliose, upper surface is greyish white, lower surface white, and rhizinate. Apothecia is rare. Width of the thallus 1-2 mm. This genus is known before only from tropical America, Africa and Philippines and New Gunea.

R.B.B. 107. Parmelia(Parmotrema)austrosinensis Zahlbr.
Corticolous, foliose, upper surface is green towards the older parts of the thallus and grey towards younger parts.Lower surface rhizinate, brown. Occur on the fresh bark of citrus trees in the orchards of Agriculture college, Tsolo. Grows to 3-5 cm in diameter. Width of the thallus varies from 5-12 mm.

R.B.B. 108. Parmelia(Xanthoparmelia)mutabilis Tayl.
Saxicolous, foliose, upper surface olive green, lower surface brown, rhizinate. It is highly evolved group in southern Africa (Hale Jr.1972). Average width of the thallus 3-5 mm.

R.B.B. 110. Physcia stellaris (L.) Nyl.
Corticolous, foliose, upper surface grey, glossy, grows on fresh bark of shrubs along Umtata river behind St. Bedes College.

R.B.B. 111. Teloschistis exelis (Michx.) Vain.
Corticolous, fruticose. Grows on the fresh bark of jacaranda trees, garden rose plants at Buntigville, Umtata General hospital. Prefers shrubs. Considerable variation in thallus colour is observed from yellow to orange red to grey or greyish white. Highly branched thalli form tufts of about 5 cm diameter. Long cylindrical very slender erect lobes. Thallus lobes are 3-4 cm long and 0.5-1 mm wide,narrows towards the tip. Tips of the thallus end like a spine. Dichotomously branched. Apothecia frequent. Apothecial discs are orange red in colour and flat. They are lateral or terminal. No hairs at the margin of the apothecia. Orange red fruiting bodies are held on stalks.

R.B.B. 113 Teloschistis hypoglaucus (Nylk.) Zahlbr.
Corticolous, fruticose lichen with foliose thallus as seen in lichens of the Himalayas (Poelt & Obermayer 1991). Thallus is divided in to many lobes. Grows to 1-2 cm in diameter. Thallus is ash grey or grey in colour. Lower surface is reticulately veined. Apothecia are numerous and they are lateral or terminal. Apothecial discs are orange red as in

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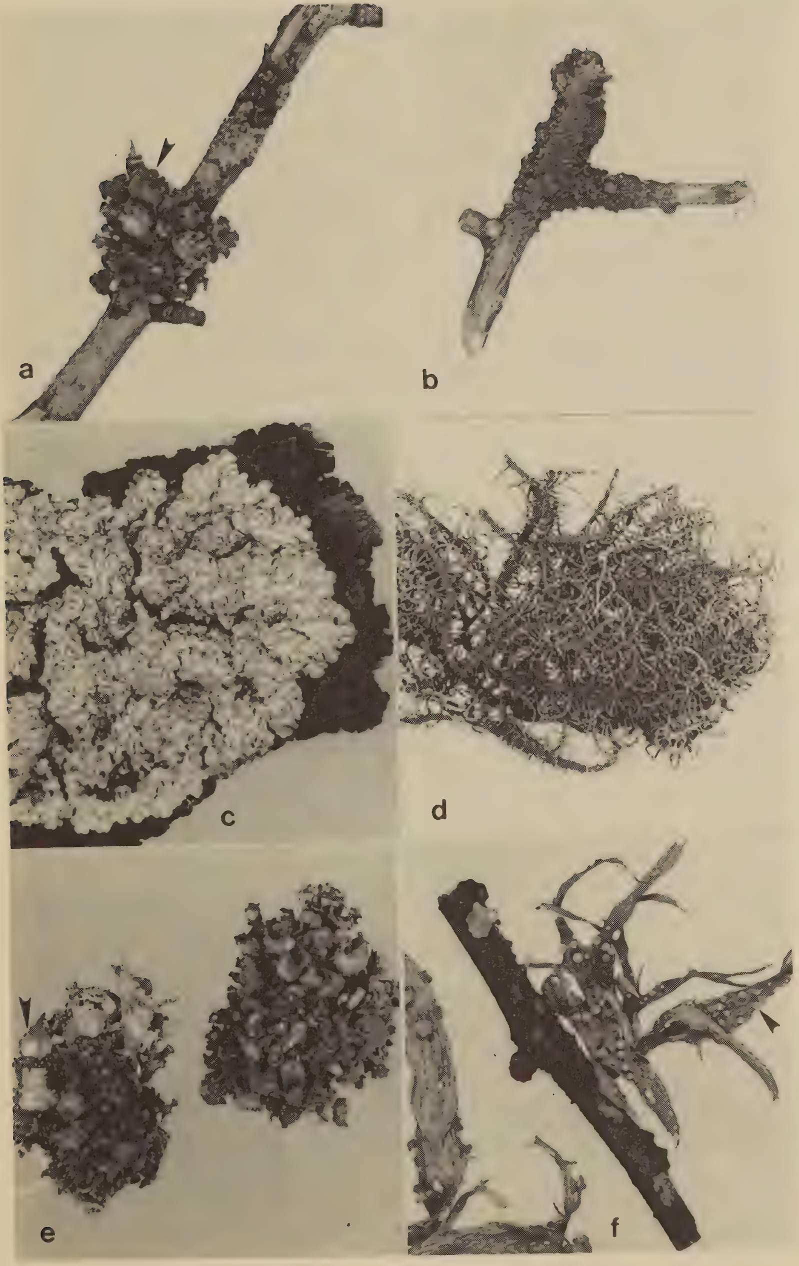
Plate 2- Upper surface of thalli of fruticose and foliose lichens. a- Teloschistes hypoglaucus with apothecia (arrow)
b- Xanthoria parietina c- Dirinaria picatata
d- Usnea undulata e- Ramalina aspera with apothecia(arrow)
f- Ramalina celastri thallus with apothecia (arrow)


a
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Xanthoria and concave, 1-2 mm in diameter. Hairy structures along the margin of the apothecia and on the thallus. Apothecia are held on short stalks. Grows on fresh bark of shady trees along gravel road to Zingiza. Occurs only in southern hemisphere,South America, South Africa and Australia (Almborn 1989).

R.B.B. 115 Usnea undulata (Stirt.)
Corticolous, fruticose, green, erect, or pendulous dichotomously branched thallus. Radially symmetrical. The thallus is attached to the substratum at one point. Grows on fresh bark on trees as well as on dry branches. Varying in height from 3-8 cm. Occurs very commonly in Hululeka Nature reserve, Engcobo, and Libode.

R.B.B. 118. Ramalina celastri (Spreng.) Krog. & Swinsc.
Corticolous, fruticose, thallus is short with broad undivided base. Thallus flat and ridged. Olive green in colour. Bilaterally symmetrical,firmly attached to the fresh bark of trees. The base of the thallus penetrate deep in to the cortex of the host plant. Thallus is branched. Apothecia are abundant and adnate, apical or sub apical or laminal varying in height from 1-8 cm. Width of the thallus varies from 3-10 mm. In some cases the lamina of the thallus has foliatious extensions. R.celastri is one of the most common species in Transkei. It is found to be widely distributed on branches which are exposed to light,mostly upper part of the trees and usually not observed to towards the base of the host plant. Photophilous.

R.B.B. 120. Ramalina aspera Ras.
Corticolous, fruticose broad and flat thallus,bilaterally symmetrical, branched, short, 1-3 cm long, 3-5 mm broad. The basal part is un-branched. Apothecia sub apical or sometimes laminal or marginal or at random held on very short stalk. Apothecial disc flat. Occurs more frequently on exposed branches of trees,therefore tolerant to high intensity of light. It is also observed on artificial habitats like parks and town avenues on fence posts roof tops. They occur more frequently on well exposed branches compared to lower branches which are shaded. Photophilous.

CONCLUSION

Fourteen lichens new to Transkei are investigated and recorded. They are mostly common or wide spread species, which indicate that most part of the Transkei and scientifically important areas are unknown from the lichenological point of view. The coastal region represents a community dominated by different species of Ramalina together with foliose and crustose lichens. As the population of Ramalina increases on the host plant the vegetative growth of that particular part decreases and slowly dies off giving a clue that it may be semi-parasite.

Further this genus shows heliotropic tendency. The altitude, strong gale from polar region, frequent changes in the elements of climate are contributing factors to the relatively small number of species in this region. Some areas are so inactive that vegetation does not have the opportunity to become established. In areas where vegetation occurs it can appear as strips and patches. Some types of lichens especially foliose and fruticose establish themselves by becoming intertwined with host plant material. Some fruticose lichens which have foliose thallus, is a special feature noted in Transkei. Similar observations have been made in some lichens in the Himalayas (Poelt & Obermayer, 1991). Lichens can be used as biological indicators because of their sensitivity to environmental pollution. Scientific research regarding the role of lichens as monitors of environmental pollution began from the middle of the century. As there is no previous comprehensive records of lichens from this regions, the rate of pollution and changes in lichen communities could not be assessed and established. No particular lichen community is reported as endangered by any agency. Any type of environmental change may have an impact on the lichen population. Growth in human population and industries in the city of Umtata and other towns may increase pollution and influence the growth of lichens and may result in the disappearance of some lichen species. Further future investigations on the lichenological studies may throw more light in this direction.

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MYCOTAXON

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BATTARREOIDES DIGUETII (GASTEROMYCETES, TULOSTOMATALES) IN SOUTHERN AFRICA

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SUMMARY

Two recent collections of Battarreoides diguetii from Botswana and South Africa confirm the occurrence of this fungus in southern Africa. The southern African material is described and its spores are compared with those of Batarrea stevenii.

KEY WORDS: Battarreoides diguetii; Batarrea stevenii; southern Africa; scanning electron microscopy.

INTRODUCTION

When Bottomley (1948) recorded Battarreoides diguetii (Pat. & Har.) R. Heim & T. Herrera [as Batarrea digueti Pat. & Har.] from the northern Transvaal in South Africa, she had little doubt that her diagnosis was correct, even though this species was, until then, known from, and believed to be confined to North America only (Cunningham, 1944). Scepticism regarding the occurrence of this fungus in Africa persisted, however, and in his authoritative Gasteromycete overview, Dring (1973) for example, still cited Battarreoides as an endemic North American genus, a view also upheld in Hawksworth et al. (1983). The disjunct distribution pattern created by the African material, which comprised of a single specimen only, and the uncharacteristic photograph in Bottomley (1948) might have contributed to this scepticism. The recent collection of three Battarreoides specimens from the Kalahari region in Botswana and South Africa was of particular significance, therefore, since it finally confirmed the southern African distribution of this genus. The Kalahari material, as well as the northern Transvaal specimen (Bottomley, 1948), largely agree to earlier descriptions of Battarreoides diguetii (Patouillard & Hariot, 1896; Rea, 1942; Herrera, 1953) and these authors believe that the southern African material should be assigned to that species.

MATERIALS AND METHODS

The description that follows is based on dried herbarium material kept in the South African National Collection of Fungi (PREM). Only three southern African collections, comprising four specimens, exist. Kreisel (1967) and Miller & Miller (1988) were followed in determining the blueing reaction of the glebal hyphae in aniline blue/lactophenol. For electron microscopy, glebal tissue of B. diguetii was affixed onto copper stubs, coated with gold in a Polaron sputter coater and examined with a Jeol 840 scanning electron microscope. For comparison, spores of two Batarrea stevenii collections (PREM 28261 and PREM 49215) were examined in the same way. Spore sizes were measured directly from the scanning electron micrographs, but capillitium measurements were obtained from material mounted in colourless lactophenol and observed through a Reichert-Jung Polyvar microscope. Colour names and codes appearing in brackets refer to the closest colour equivalents in the "Methuen Handbook of Colour" (Kornerup & Wanscher, 1978).

DESCRIPTION

Battarreoides diguetii (Pat. et Har.) R. Heim et T. Herrera, An. Inst. Biol. Mex. 32: 30 (1961).
≡ Batarrea Digueti Patouillard et Hariot, Journ. de Botanique 10(15): 251, pl. II (1896).
≡ Battarraeastrum Digueti (Pat. et Har.) R. Heim et T. Herrera, Rev. de Mycol. 25(3-4): 217, pl. IX (1960).
= Battarrea Griffithsii Underwood, Bull. Torrey Bot. Club 28: 440, pl. 37 (1901).
= Battarrea Digueti forma minor Lloyd, Myc. Writ. 7(3): 1175, pl. 228, fig. 2335 (1923).
= Battarreoides potosinus T. Herrera, An. Inst. Biol. Mex. 24: 41-46 (1953).

Basidiocarp stipitate. Peridium attached more or less centrally on the stipe apex, campanulate, 30-51 mm wide, up to 30 mm high, but only up to 12 mm separating the peridial apex from the point of attachment to the stipe. A narrow, protruding, membraneous margin demarcates the junction between the convex upper and concave bottom peridial halves (zone of circumscissile dehiscence in Batarrea). Exoperidium creamish white (yellowish white; 4A2), thin, brittle, fugacious, virtually absent on some (usually weathered) specimens. Endoperidium concolourous with exoperidium, smooth, texture tough and springy, dehiscing by means of pores mostly arranged in a circle along the peridial circumference, a few millimetres above the junction of the upper and lower peridial halves. Stipe

yellowish cream (pale yellow; 4A3) or blackish brown (although more brownish towards the base), up to 27,5 cm long, 9-12 mm wide, cylindrical but attenuating towards the base, hollow, smooth to squamose, may be deeply sulcate, lacerating into large linear, fibrous scales, more so towards the base, sometimes contorted, the sulcations then spiralling along the length of the stipe. Gleba cobwebby, dark brown (dark brown; 7F8), adherent to the base of the endoperidium, comprised of elaters, spores and hyaline to very faintly pigmented hyphae (both thin walled and skeletal), 2-7 μm in diameter. Thin-walled hyphae abundant, comprising single hyphae to amorphous, tissue-like mycelial aggregates, sparsely septate, occasionally branched. Skeletal hyphae (capillitium) thick walled (up to 1,75 μm), rarely branched, apparently aseptate, cyanophilic, arising from thin walled hyphae. Elaters 2,5-8,75 μm in diameter (mostly varying between 4,5-6,25 μm), consisting of very short to longer fragments usually not exceeding much more than 160 μm in length (although lengths of up to 210 μm have been measured), occasionally branched, often with tapering, rounded ends. Elater walls hyaline and thin but with numerous annular (occasionally spiral), wall thickenings, yellowish brown in colourless lactophenol and positively cyanophilic upon heating in aniline blue/lactophenol. Basidia: immature stages not preserved to record these cells. Basidiospores dark rusty brown (dark brown; 7F8), globose to broadly oval, 4,2-6,9 μm long and 4,6-5,6 μm broad, very shortly pedicelled (0,5 μm), appearing pitted under the light microscope but with a distinctly reticulate wall sculpture on the electron micrographs. Volva not observed.
Habitat: Arid soil; sand dune; termite mound.
Distribution in Africa: northern Transvaal and north western Cape, South Africa; central Botswana.
Distribution elsewhere: North America.
Icones: Patouillard & Hariot (1896), White (1901), Lloyd (1906), Lloyd (1923), Rea (1942), Bottomley (1948), Herrera (1953), Heim & Herrera (1960).
Material examined: SOUTH AFRICA: Botanic Reserve near Messina, northern Transvaal, on termite mound, I.B. Pole Evans PREM 20459, August 1925. Groblershoop, north western Cape Province, on sand dune, M.C. Moolman, PREM 49432, March 1989. BOTSWANA: Approximately 8 km West of Tsutswa pan (approx. 63 km West of Hukuntzi), Kgalagadi district, on sandy soil, G.D. Joubert PREM 51435, 13.9.89.

DISCUSSION

Macroscopically, the monotypic genus Battarreoides differs from Batarrea by the endoperidium which dehisces by multiple pores instead of circumscissilely. The most significant microscopic difference between the two genera lies in the relative lengths of the elaters, which in Batarrea seldomly exceed 80 μm, while lengths of between 100-200 μm are common in Battarreoides (Rea, 1942; Miller & Miller, 1988).

Although the photograph of Battarreoides diguetii in Bottomley (1948) depicts a specimen without peridial perforations, re-examination of Bottomley's material (PREM 20459) did reveal distinctive perforations in that part of the peridium not visible in the photograph. Examination and careful comparison of all the southern African specimens convinced us of their conspecificity and position in the genus Battarreoides.

The southern African Battarreoides specimens do not differ significantly from earlier descriptions and illustrations of B. diguetii (Patouillard & Hariot, 1896; White, 1901; Lloyd, 1906; Lloyd, 1923; Rea, 1942; Herrera, 1953; Heim & Herrera, 1960) and we have little doubt that they represent the same species. The peridial perforations in our specimens are largely restricted to a circular arrangement and, with one exception, are not scattered over the peridial surface as reported by Patouillard & Hariot (1896) and Herrera (1953). This seems to be a variable characteristic, however, as a circular arrangement had also been reported for a number of specimens examined by Herrera (1953). Most authors describe the gleba as pulverulent and not cobwebby as interpreted by Lloyd (1923) and ourselves. This character also seems to vary, and is speculated to be a function of the age of the fruiting body at the time of collection. The only major difference between the southern African and North American material appears to be the absence of a volva in the former. This, however, is a structure that could easily be overlooked by the inexperienced collector and from earlier illustrations it is evident that the volva is not always included in herbarium specimens (Lloyd, 1923; Rea, 1942; Heim & Herrera, 1960). All the southern African collections were made by non-mycologists and the absence of the volva is therefore most likely to have been caused by collector ignorance.

The spore ornamentation of B. digueti has been interpreted as warted, reticulated or perforate (Rea, 1942), obscurely verrucose (Patouillard & Hariot, 1896) and finely bristly (Herrera, 1953). Under the SEM, spores of the southern African collections were, however, distinctly reticulate (Figures 1a and 1b). By this characteristic alone, the Battarreoides specimens were clearly distinguishable from Batarrea stevenii which had spores of a more verrucose nature (Figures 1c and 1d). The reticulate spore ornamentation, lack of circumscissile dehiscence and long elaters thus form a combination of characteristics which distinguish Battarreoides from Batarrea. This is in conflict with the results of a SEM study by Liu and Liu (1983), however, who reported and

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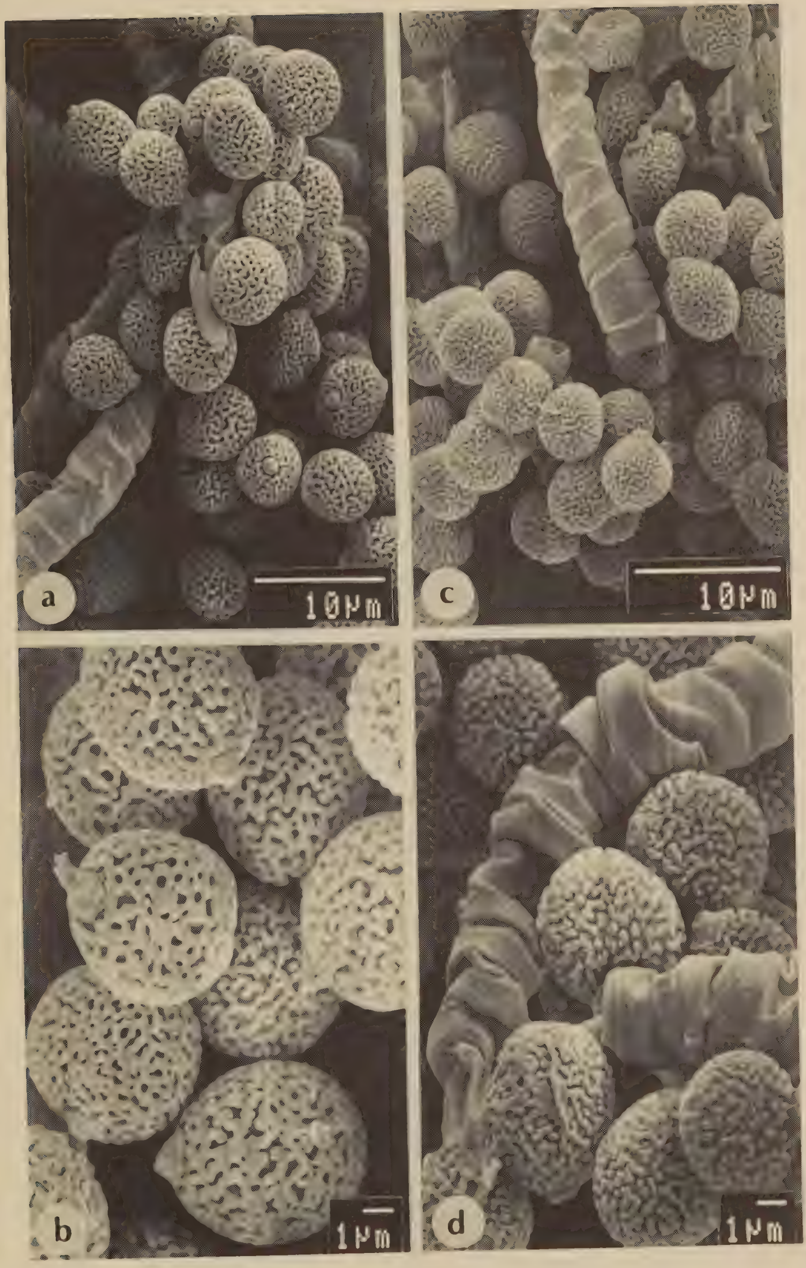
Fig. 1. a-b. Basidiospores of Battarreoides diguetii.
c-d. Basidiospores and elaters of Batarrea stevenii.


a
10µm
c
10µm
b
1µm
d
1µm

illustrated reticulate spores, closely resembling those of our Battarreoides diguetii specimens, for Batarrea stevenii. This apparent discrepancy requires an examination of the sporophores used in their study for elater length and circumscissile dehiscence. It is probable that the spores described by Liu and Liu (1983) were not those of Batarrea stevenii.

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MYCOTAXON

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TYPE STUDIES IN THE POLYPORACEAE 25
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ABSTRACT

The types of 32 polypores described by R. Imazeki and A. Yasuda have been examined. 17 species are accepted while 15 are placed in synonymy with already described species. The following new combinations are proposed: *Melanoporia castanea* (Imaz.) Hatt.& Ryv., *Antrodiella gypsea* (Yas.) Hatt. & Ryv., *Perenniporia japonica* (Yas.) Hatt. & Ryv., *Perenniporia minutissima* (Yas.) Hatt. & Ryv. and *Trichaptum parvulus* (Yasuda) Hatt. & Ryv.

INTRODUCTION

The polypore flora of Japan is incompletely known and the latest comprehensive list is that of Ito (1955). However, numerous resupinate species were omitted while many species have later been reported from the country, see for example Aoshima & Kobayashi (1983) and Furukawa, Abe & Neda (1983). Further, the nomenclature in Ito's list is outdated, making it difficult to use the list.

The flora of North American polypores (Gilbertson & Ryvarden 1986 & 1987) gave an updated checklist for the North American continent using the same nomenclature as in Europe (see Ryvarden & Gilbertson 1993). These publications have made comparative studies much easier since the names used in the two areas now are in consensus.

From Ito's list and more popular floras like those of Imazeki & Hongo (1965, 1989), it is evident that Japan has many polypores in common with both Europe and North America. Some of them have been named anew in Japan while others are cited with synonyms. Thus, we felt it necessary to make up a critical checklist for the polypores of Japan as a first preliminary step towards a complete flora. During the compilation of names of polypores recorded from Japan, it became clear that a number of types

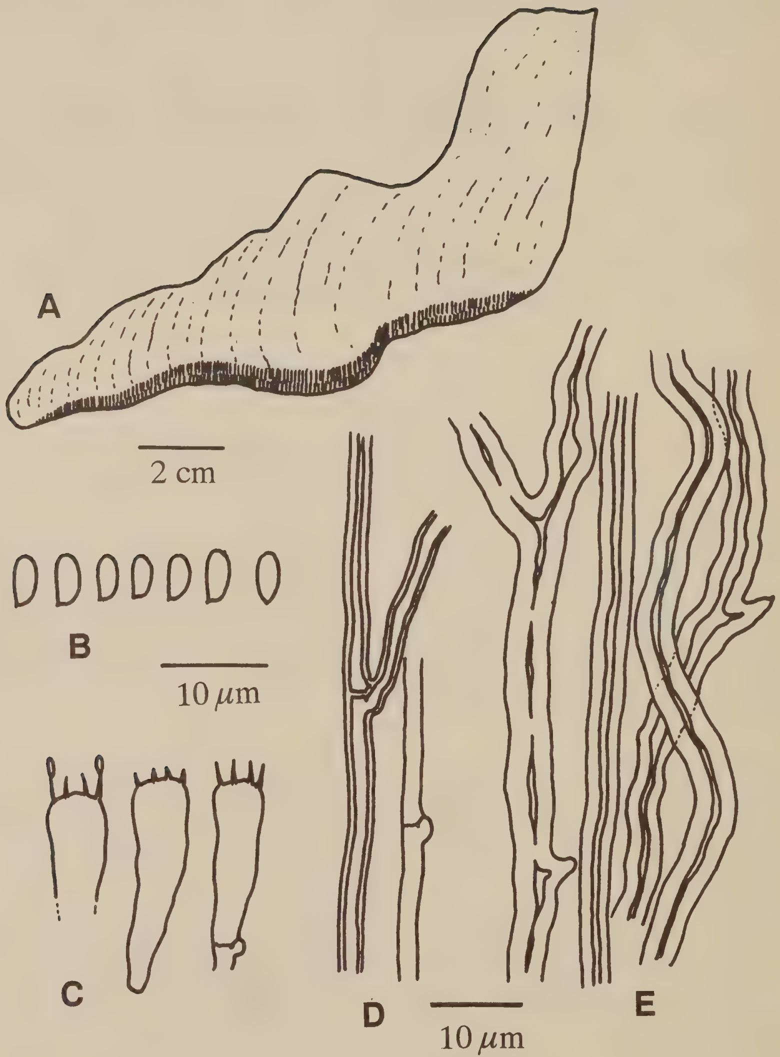

Fig. 1. *Melanoporia castanea* A) section of basidiocarp, B) basidiospores, C) basidia, D) contextual generative hyphae, E) contextual skeletal hyphae. A,D and E from the type, B and C from TFM-F-15770.

had to be examined to ascertain the status of a number of names which more or less had slept in oblivion since their publication. The results of these studies are published below to avoid excessive taxonomic discussions and descriptions in the forthcoming checklist.

The two authors cited in the title are the only Japanese mycologists who have published new polypores from the main land of Japan. Bonin Island has a very distinct mycoflora being situated 1,000 km SE of Japanese main islands, and its polypores will be treated in a series of separate papers. Thus, we felt it natural to treat R. Imazeki and A. Yasuda species in one paper.

C. G. Lloyd described many species from Japan based on collections from Yasuda. The results of studies on the types of these species have already been published in previous parts of this series. The reader is referred to Ryvarden (1991) for a complete list of previous type studies and a list of all species treated in the series up to 1991.

In the following, species of both authors are listed alphabetically according to specific epithet. For each species the place of publication is given with the type locality and the herbarium in which the type is deposited. The herbaria are indicated with the abbreviations as given in Index Herbariorum, 7th edition.

K. Aoshima proposed many names for new polypores from Japan. However, unfortunately he overlooked the rules of the International Code of Botanical Nomenclature. Thus, all his new names, mostly as nomina nuda, must be rejected as invalidly published for different reasons.

If the species is accepted, it is cited in its proper genus with a reference to a modern description. If none exist, the species is described here. The basionyms and the accepted names are printed in bold face.

LIST OF SPECIES

albicans, Grifola Imaz., J. Jap. Bot. 19:386, 1943.

Yabukawa, Iwate Pref., Japan, 29 Sep. 1938, leg. K. Ito (lectotype selected here, TNS-206974).= *Grifola frondosa* (Fr.) S.F.Gray The type specimen represents only a pale form of the widespread *G. frondosa*. Imazeki (1943) concluded that it is distinct with its very wide context hyphae, but such wide hyphae are also seen in many specimens of *G. frondosa*.

calvatioides, Polyporus Imaz. J. Jap. Bot. 16:269, 1940.

Summer, 1917, leg. J.Umemura (Type of *Calvatia versispora* Lloyd, BPI).

= *Laetiporus versisporus* (Lloyd) Imaz.

P. calvatioides was proposed as nomen novum (for use in the genus *Polyporus*) by Imazeki because the combination *Polyporus versisporus* Lloyd was an illegitimate homonym of *Polyporus versisporus* Pers. 1825.

castanea, Fomitopsis Imaz., Bull. Gov. Forest Exp. St. Tokyo 42:1, 1949.

Kitasaku, Nagano, Japan, 9 Oct. 1947, leg. R. Imazeki (type, TFM- F-346; isotype in TNS).

=**Melanoporia castanea** (Imaz.) Hattori & Ryvarden comb. nov., basionym as

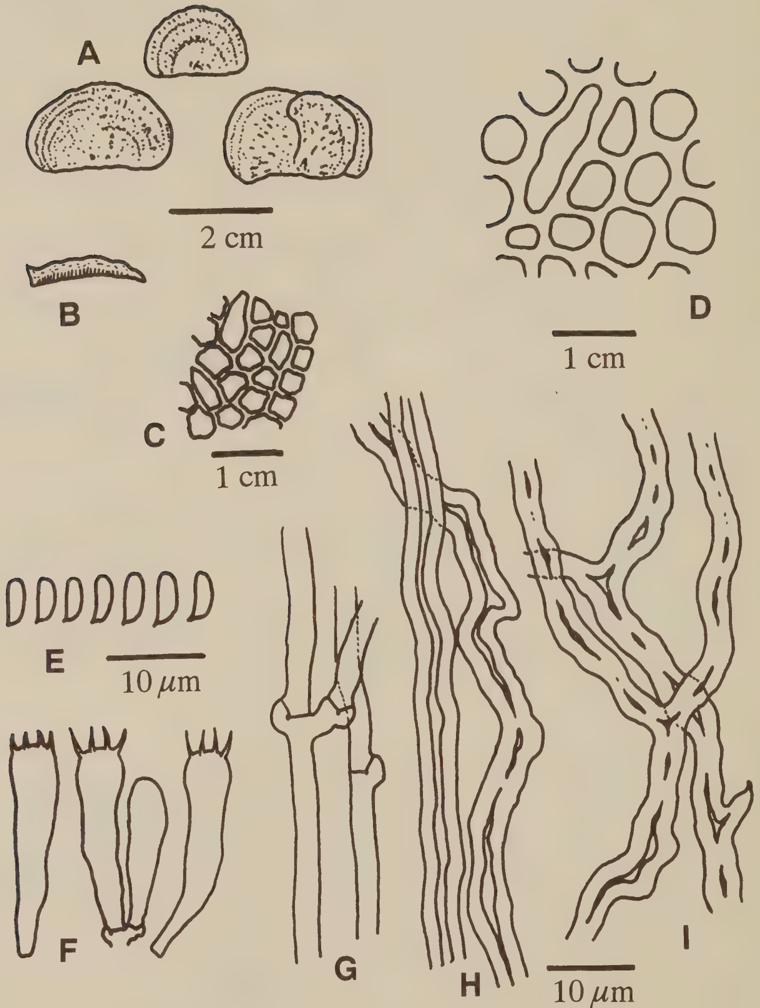

Fig. 2. A-C: *Daedaleopsis conchiformis* A) basidiocarps, B) section of basidiocarp, C) pores. From the type. D-I: *Daedalea dickensii* D) pores, C) basidiospores, F) basidia, G) contextual generative hyphae, H) contextual skeletal hyphae, I) contextual binding hyphae. D, G-I from the lectotype; E and F from TFM-F-16200.

cited above.

Basidiocarp sessile, occasionally resupinate, perennial; pileus triquetrous, ungulate or irregular, up to 30 cm long, up to 15 cm thick, margin thick and dull, pileus surface chestnut brown and velutinous in young specimens, almost black and glabrous in old specimens; tubes multizonate, purplish brown, pore surface dark umber to purplish brown, pores circular, 5-6 /mm; context fibrous-corky, purplish brown.

Hyphal system dimitic, contextual generative hyphae hyaline, 1.5-4 µm wide, with clamp connections; contextual skeletal hyphae olivaceous brown in KOH, 3-5.5 µm wide, thick to almost solid, unbranched to occasionally branched; tramal generative hyphae hyaline to pale yellow, 1.5-3 µm wide, with clamp connections; tramal skeletal hyphae olivaceous brown in KOH, almost straight, thick to almost solid, 3-5 µm wide; cystidia none. Type sterile, so following descriptions of basidia and basidiospores were made based on TFM-F-15770. Basidia clavate, 15-20 x 4.5-5 µm, 4-sterigmate, with a basal clamp, basidiospores long ellipsoid, hyaline, IKI$^-$, 4-5 x 1.8-2.5 µm (Fig. 1).

Remarks: This species is closely related to *Melanoporia nigra* (Berk.) Murr.(basionym *Polyporus nigra* Berk., K, BPI!) with its purplish brown context and brown rot. Thus, Imazeki & Hongo (1989) reduced it to a synonym of *M. nigra*. However, *M. nigra* has a consistently resupinate basidiocarp while *M. castanea* usually has a well developed pileus. Besides, the context hyphae of *M. nigra* are much wider than those of *M. castanea*.

cercidiphyllum, Cryptoderma Imaz., Bull. Gov. Forest Exp. St. Tokyo 42:2,1949.

Shibetsu, Hokkaido, Japan, 23 July 1941, leg. R. Imazeki (type, TNS-212095).

= *Phellinus conchatus* (Pers.:Fr.) Pat. as already pointed out by Aoshima (1983).

citrinum, Cryptoderma Imaz., Bull. Tokyo Sci. Mus. 6:107, 1943.

Tano-cho, Miyazaki, Japan, leg. T. Nukumizu (neotype selected here, TFM-F-2420).

= *Phellinus xeranticus* (Berk.) Pegler, as already pointed out by Imazeki et al. (1966). For a detailed description of this species, see Pegler (1964) and Ryvarden & Johansen (1980). Coloured pictures are given in Imazeki & Hongo (1989) and Imazeki et al (1990).

conchiformis, Daedaleopsis Imaz., Bull. Tokyo Sci. Mus. 6:77, 1943. Accepted in the genus.

Sendai, Miyagi, Japan, on *Quercus serrata* Thunb., May 1907, leg. A. Yasuda, (type in BPI as type of *Trametes tricolor* Lloyd, BPI-US0321332).

Basidiocarp sessile; pileus dimidiate, applanate, imbricated, 2-6 cm long, 0.3-0.6 cm thick, margin thin and acute, deflexed; pileus surface cinnamon to chestnut brown, glabrous, subzonate, concentrically sulcate or not, radially ridged and partly rough; tubes pale brown, 1-4 mm deep; pore surface grayish brown, pores mostly regular and angular, partly elongated, (1-)2-3 /mm, dissepiments thin and becoming lacerate; context corky, pale brown, 1-2 mm thick.

Hyphal system trimitic, contextual generative hyphae hyaline, thin walled, 2-3 µm, with clamp-connections; contextual skeletal hyphae thick-walled, hyaline to pale yellow, unbranched to occasionally branched, 3-7.5 µm wide in KOH (2.5-5 µm wide in

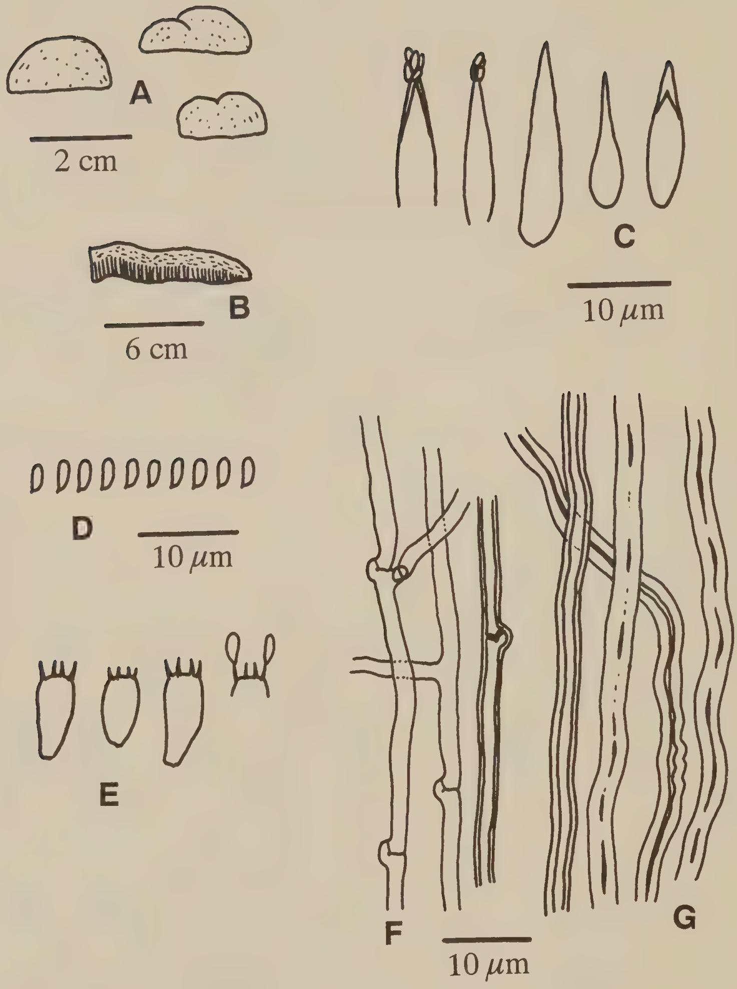
A
2 cm
B
6 cm
C
10 μm
D
10 μm
E
F
10 μm
G

Fig. 3. *Antrodiella gypsea* A) basidiocarps, B) section of basidiocarp, C) cystidia, D) basidiospores, E) basidia, F) contextual generative hyphae, G) contextual skeletal hyphae. From the lectotype.

Melzer's reagent); contextual binding hyphae thick-walled, hyaline to pale yellow, conspicuously branched, up to 5µm wide in KOH; tramal hyphae as in context hyphae; basidia and basidiospores not seen in type material (Fig.2, A-C).

Remarks: This species is closely related to *D. confragosa*, but has smaller pores and basidiocarps. Spores are not known from the type nor from other collections, but other microscopic characteristics are rather similar to those of *D. confragosa*. Cultural studies and mating tests are needed to decide whether they are distinct species or only a form of the same species.

It was first named as *Trametes tricolor* Lloyd as it was taken as a trametoid form of *Lenzites tricolor*. As the combination *Daedaleopsis tricolor* was preoccupied by *Daedaleopsis tricolor* (Bull.:Fr.) Bond. & Sing., the name cited above was proposed by Imazeki.

dickinsii, Daedalea Yasuda, Bot. Mag. Tokyo 36:127, 1922.

Sendai, Prov. Rikuzen (Miyagi Pref.), leg. A. Yasuda (lectotype, selected here, TNS-202243, isotype in TFM).

Accepted in the genus.

This is only a partly daedaleoid form of *Trametes dickinsii* Cke. as pointed out by Yasuda himself (1923). Ryvarden (1988) placed this species in synonymy with *Daedalea incana* (Lèv.) Ryv. However, a comparison and a renewed examination of the type from the Paris herbarium (PC) has shown that *D. incana* has much smaller pores and a more brownish context. Thus, we concluded that *D. dickensii* is a distinct species.

Trametes dickinsii Cke. (1891) has priority over *D. dickinsii* Yas. Yasuda (1922), but Cooke's name cannot be transferred to *Daedalea*, since the name is preoccupied by that of Yasuda. His name will then be the valid name as long as the species is placed in *Daedalea*. In all other combinations, the basionym must be that of Cooke.

Basidiocarp sessile, annual to perennial, pileus dimidiate, applanate to triquetrous, up to 20 cm long, 10 cm wide, and 5 cm thick, margin usually dull; pilear surface pale ochraceous to pinkish buff, inner parts often brownish in old specimens, glabrous, smooth or with scattered nodulae or irregularly rough, concentrically sulcate or not; tubes up to 15 mm deep;, pores usually circular, partly elongated to daedaleoid, 1-2/mm, dissepiments thick and smooth; context tough corky, pinkish buff, up to 20 mm thick.

Hyphal system trimitic; contextual generative hyphae hyaline, thin-walled, 1.5-3 µm wide, with clamp-connections; contextual skeletal hyphae hyaline to pale brown, thick-walled to almost solid, unbranched to occasionally branched, 2.5-4.5 µm wide; contextual binding hyphae moderately branched, up to 4.5 µm wide; tramal hyphae as in context; type sterile, so following descriptions of basidia and basidiospores were made based on TFM-F-16200; basidia 18-25 x 4.5-6 µm, 4-sterigmate, with a basal clamp; basidiospores cylindrical, hyaline, IKI⁻, 4-5.5 x 1.8-2.5 µm (Fig.2, D-I).

Remarks: The species is very common in temperate areas of Japan, most commonly on *Fagus crenata* and *Quercus* spp. Bakshi (1971) reported the species from Himalayas (specimens in DD examined), and Hjortstam & Ryvarden (1984),

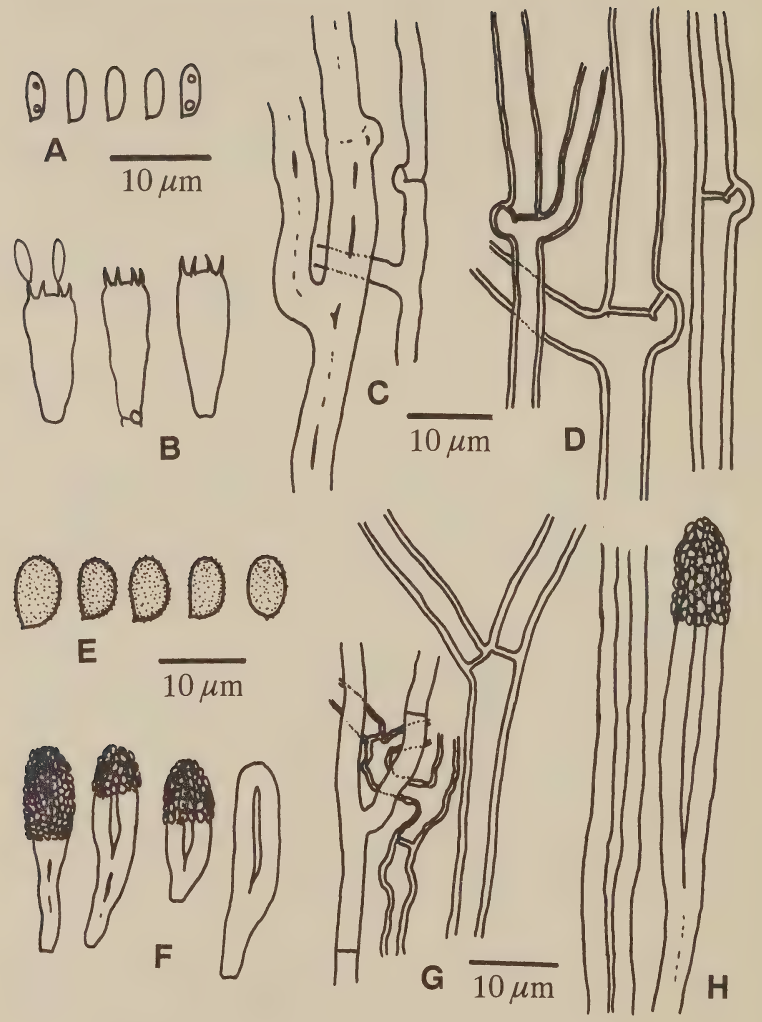

Fig. 4. A-D: *Tyromyces incarnatus* A) basidiospores, B) basidia, C) tramal generative hyphae, D) contextual generative hyphae. A and B from TFM-F-15116; C and D from the lectotype. E-H: *Echinodontium japonicum* E) basidiospores, F) cystidia, G) generative hyphae, H) skeletal hyphae. from the type.

Ryvarden et al. (1986) reported this from Nepal and China respectively under the name of *D. incana*. It is probably widespread in temperate areas of eastern Asia.

There is no doubt that *D. dickinsii* is closely related to the widespread *Daedalea quercina* Fr., separated only by the smaller and more regular pores. Comparative cultural studies and interfertility tests are desirable to ascertain their interrelationship.

gypseus, Polystictus Yasuda, Bot. Mag. Tokyo 32:249, 1918.

Sendai, Rikuzen (Miyagi), Japan, 26 May 1912, leg. A. Yasuda (lectotype, selected here, TNS-201855, isotype in TFM).

= **Antrodiella gypsea** (Yasuda) Hattori & Ryvarden comb. nov., basionym as cited above.

Basidiocarp sessile, effused-reflexed or occasionally fully resupinate, annual, very light in weight; pilei dimidiate or laterally fused and elongated, imbricated or single, up to 2 cm long and 1 cm wide in single pilei, up to 3 mm thick, margin usually acute; pilear surface pubescent, radially sulcate or not, white; tubes white, up to 1.5 mm deep; pore surface white, pores angular, 5-6/mm; context soft-fibrous, white, up to 2 mm thick.

Hyphal system dimitic; contextual generative hyphae hyaline, thin to slightly thick-walled, 1.5-2 µm wide, with clamp-connections, contextual skeletal hyphae hyaline, thick walled, almost straight, 2-3 µm wide; tramal generative hyphae hyaline, 1.5-2 µm wide, with clamp-connections; tramal skeletal hyphae hyaline, thick to almost solid, 2-2.5 µm wide; cystidia scattered, acute, thin to slightly thick-walled at the tip, encrusted at the tip or not; hyphal pegs abundant; basidia ellipsoid, 4-sterigmate, 6-9 x 3-4.2 µm; basidiospores long ellipsoid, hyaline, IKI^-, thin walled, 2.2-3 x 1.0-1.5 µm (Fig.3).

Remarks. The dimitic hyphal system with clamped generative hyphae, small spores, a fleshy consistency, and a white rot, make this a typical member of *Antrodiella*. It is common in Japan on coniferous trees including species of *Abies*, *Chamaecyparis* and *Cryptomeria*.

A. gypsea is similar to *Oxyporus cuneatus* (Murr.) Aosh. with the same white and soft-fibrous basidiocarp and host range, but the latter species has larger pores, and the hyphal characteristics are very different.

hispida, Protodaedalea Imaz., Rev. Mycol. 20:159, 1955.

Oomiya-guti, Mt. Fuji, 4 Aug. 1954, leg. Toki (lectotype, selected here in TNS, isotype in TFM).

= Accepted in the genus.

For a detailed description of this interesting poroid heterobasidiomycete, see Bandoni et al. (1981).

incarnatus, Tyromyces Imaz., Bull. Gov. Forest Exp. Sta. Tokyo 67: 31, 1954.

Asakawa, Tokyo, Japan, on rotten wood of *Abies firma* Sieb. & Zucc., 30 July 1938, leg. R. Imazeki (lectotype selected here, TNS; isotype in TFM).

= **Tyromyces incarnatus** Imaz.

Basidiocarp sessile, annual; pileus spatulate, flabelliform to dimidiate, applanate, up to 10 cm long, 1 cm thick, margin thin and acute; upper surface pink, rose to reddish orange, drying darker, glabrous, smooth to somewhat nodulose; tubes up to 5 mm deep, pinkish white; pore surface pinkish, pores circular, 3-4/mm, dissepiments thin; context sappy when fresh, drying rigid, up to 7 mm thick.

Hyphal system monomitic; contextual generative hyphae hyaline, thin to slightly thick walled and with clamps, 2.5-6 µm wide, tramal generative hyphae hyaline, thin- or thick-walled to almost solid, 2-5 µm wide; cystidia none. Type sterile and contaminated, and the following descriptions of basidia and basidiospores were made based on TFM-F-15116; basidia clavate, 4-sterigmate, with a basal clamp, 12-16 x 4.5-5.5 µm; basidiospores hyaline, IKI$^-$, thin walled, 4-5 x 1.5-2.5 µm (Fig.4, A-D).

Remarks: The species is remarkable by its reddish basidiocarp and host range (always on conifers) within the genus *Tyromyces*. Macroscopically the species remind about *Leptoporus mollis* (Pers.:Fr.) Quèl. which however has simple septate hyphae.

japonica, Trametes Yasuda, Bot. Mag. Tokyo 32:356, 1918.

Sumoto, Awaji, Japan, 17 Mar. 1918, leg. J. Matsuzawa. (lectotype, selected here, BPI-US0320326)

= **Perenniporia japonica** (Yasuda) Hattori & Ryvarden comb. nov., basionym as cited above.

This is a prior name for *Perenniporia fulviseda* (Bres.) Dhanda (Basionym: *Poria fulviseda* Bres., BPI!). For a detailed description of this characteristic species, see Keller (1986) as *P. fulviseda*. Besides central Europe, it is also known from the Himalayas (Thind & Dhanda 1981), specimen in BPI examined).

japonicum, Echinodontium Imaz. J. Jap. Bot. 11:520, 1935.

Hana-yama, Nara, Japan, 11 May 1933, leg. R. Imazeki, on *Quercus glauca* Thunb. (type TNS-200301, isotype in TFM).

= Accepted in the genus.

The species is described in Gross monograph of the genus (Gross 1964) where clearly points to the close relationship to the East American species *E. ballouii* (Banker) Gross. Never the less, to draw the attention to this rare species it is redescribed here.

Basidiocarp effused-reflexed to almost resupinate, perennial; pileus irregular to lacking, up to 4 mm wide; pilear surface almost black, crustaceous, glabrous, smooth to slightly rough; hymenophore spiny, spines sordid white to pale buff, rigid, up to 10 mm long, up to 0.5 mm in diameter, often flattened or forked; context woody hard, cinnamon, up to 1 mm thick, with black shiny crust next to substrate.

Hyphal system dimitic; contextual generative hyphae thin to slightly thick-walled, hyaline to pale yellow, simple septate with some scattered clamps, 2-4 µm wide; contextual skeletal hyphae thick walled, pale brown, occasionally encrusted at the tip, 3-6 µm wide; tramal hyphae as in context hyphae; cystidia abundant, thick-walled, pale brown, apically encrusted, mostly imbedded in the trama, 30-50 x 7.5-10.5 µm; basidia not seen; basidiospores ellipsoid, finely echinulate, hyaline, strongly amyloid in Melzer's reagent, 5.5-7.5 x 3.2-4.5 µm (Fig.4, E-G). See, also Imazeki (1935).

Remarks: *E. japonicum* is a very rare species in Japan and restricted to species of *Quercus.*

kanehirae, Polyporus Yasuda, Bot. Mag. Tokyo 35:205, 1921.

Mt.Yura, Taiwan, 3 Apr. 1918, leg. R. Kanehira. (type TNS-201566, isotype in TFM)

= **Phellinus kanehirae** (Yasuda) Ryv.

This species is apparently related to *Phellinus nilgheriensis* (Mont.) Ryv. (Basionym *Polyporus nilgheriensis* Mont., cotype in K selected here as lectotype). The only distinction between them is the occurrence of setae which are abundant in *P. kanehirae* and extremely sparse in *P. nilgheriensis.* Thus, it is a possibility that they represent forms of the same species. For a detailed description of *P. kanehirae*, see Ryvarden (1990).

kiyosumiensis, Fomitopsis Imaz. & Sasaki nom. nud. in S. Ito, Mycol. Flora of Japan Vol.2 No.4, 1955.

= *Perenniporia latissima* (Bres.) Ryv. as already indicated by Imazeki & Hongo (1965).

komatsuzakii, Polyporus Yasuda, Bot. Mag. Tokyo 31:329, 1917.

Isozaki, Iyo, Japan, 10 Dec. 1916, leg. M. Komatsuzaki. (lectotype, selected here, TNS-201420)

=*Piptoporus soloniensis* (Dub.:Fr.) Pilat.

The type is sterile but spore measurements given by Yasuda are those of *P. soloniensis*, and they have the same hyphal system. The context of the type is extremely fragile and grayish compared with *P. soloniensis.* For the time being, we prefer to leave it as a synonym of that species.

kusanoana, Trametes Imaz. Bull. Tokyo Sci. Mus. 6:73, 1943.

Bot. Gdn. Tokyo, Japan, 1901, leg. S. Kusano (type of *Daedalea kusanoi*, Murr., NY).

= *Lenzites vespacea* (Pers.) Ryv.

The name cited above was proposed by Imazeki as nomen novum for *Daedalea kusanoi* Murr. as the combination "*Trametes kusanoi*" was preoccupied by *Trametes kusanoi* (Murr.) Sacc. & Trott. (basionym *Coriolellus kusanoi* Murr.).

minutissima, Trametes Yasuda, Bot. Mag. Tokyo 34:29, 1920.

Fujishiro, Ibaraki, Japan, 1 Oct. 1919, leg. Y. Irie. (Neotype selected here, TNS-202074)

= *Perenniporia minutissima* (Yasuda) Hattori & Ryvarden comb.nov., basionym as cited above.

Basidiocarp sessile, single, annual; pileus dimidiate, triquetrous to applanate, 75 x 60 mm in type specimen (up to 10 cm long and 2 cm thick in other specimens in fresh condition), margin thick and dull; pilear surface reddish brown, almost white near margin, glabrous, irregularly rough to almost smooth; tubes white, 5 mm deep in type; pore surface white, pores circular, 3-5/mm; context white, woody hard when dry (waxy and fragile with abundant semitransparent spots in fresh condition), up to 8 mm thick in type.

Hyphal system di-trimitic; contextual generative hyphae hyaline, thin to slightly thick-walled, with clamp-connections, 2-3.5 µm wide; contextual skeletal-binding

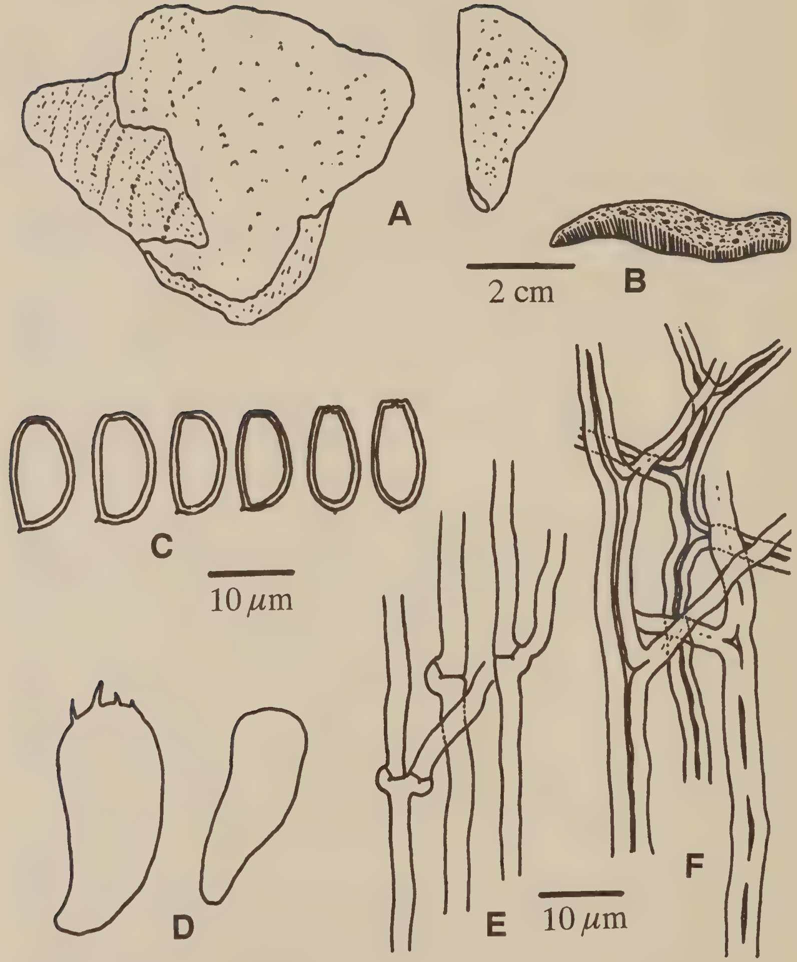

Fig. 5. *Perenniporia minutissima* A) basidiocarps, B) section of basidiocarp, C) basidiospores, D) basidia, E) contextual generative hyphae, F) contextual skeletal-binding hyphae. from the neotype.

hyphae hyaline, dextrinoid in mass, thick-walled, 2.5-5 µm wide; tramal hyphae agglutinated; cystidia none; basidia 4-sterigmate, with a basal clamp, 20-30 x 9-12.5 µm; basidiospores ellipsoid, truncate at the apex, thick walled, hyaline, dextrinoid in Melzer's reagent, 10-13 x 6-7.5 µm (Fig.5).

This species is remarkable within the genus *Perenniporia* by its waxy consistency of the context in fresh condition. Most collections seen so far have been made on *Symplocos* spp. Some specimens were also collected on *Pinus densiflora*. Microscopically the species comes close to *P. ochroleuca* (Berk.) Ryv. which however has rather small triquetrous perennial basidiocarps with a pale ochraceous upper side. **neo-japonicum, Ganoderma** Imaz., Bull. Tokyo Sci. Mus. 1:37, 1939. Mt.Takao, Tokyo, Japan, Aug. 1935, leg. Y. Kobayasi (type, TNS- 200762).

This species is a member of the *Ganoderma lucidum* complex. For the time being, we prefer to keep it separate as *Ganoderma neo-japonicum* Imaz.

Basidiocarp laterally or occasionally centrally stipitate, annual; pileus reniform to dimidiate, applanate, margin thin and deflexed, 3-11 x 4-11 cm; pilear surface almost black, glabrous, laccate and shiny, radially ridged; tubes dark cinnamon, 0.2-1 cm deep; pore surface sordid white to cinnamon, pores angular to circular, 4-5/mm; context cream white near pilear surface, dark cinnamon near tubes, fibrous-corky, up to 7 mm thick; stipe erect, 9 cm long in type material (up to 27 cm long in other specimens), stipe surface black and laccate.

Hyphal system di-trimitic; contextual generative hyphae not seen in the type; context skeletal-binding hyphae pale yellow to brown, rarely to conspicuously branched, up to 7.5 µm wide; tramal hyphae as in context; basidia not seen; basidiospores ellipsoid, truncate at the apex, pale brown, wall two-layered with inter-wall pillars between the layers, (8.5-)9.5-13 x 6-8 µm.

The species is remarkable with its slender long spores, a black shiny basidiocarp, slender stipe and host range (always on coniferous trees). Coloured pictures are given in Imazeki & Hongo (1989) and Imazeki et al (1988).

nipponica, Daedaleopsis Imaz., Bull. Tokyo Sci. Mus. 6:78, 1943.

Nikko, Tochigi, Japan, 7 Nov. 1938, leg. R. Imazeki (type, TNS- 208958).

= *Daedaleopsis purpurea* (Cke.) Imaz. & Aosh. as already indicated by Imazeki et al. (1966) where also a detailed description can be found.

In Japan, *D. purpurea* is common on hardwood especially on *Prunus* spp. The species is characterized by its regular pores and a multizonate, red to bay pileus surface. The latter character is shared with *D. tricolor* and *D. styracina* (P.Henn. & Shir.) Imaz. which however have lamellae, and lamellae or large irregular pores respectively.

nipponicus, Polystictus Yasuda, Bot. Mag. Tokyo 30:297, 1916.

Mt.Akagi, Kotsuke, Japan, 28 Sep. 1915, coll. K. Tsunoda (lectotype, selected here, TNS-201758, isotype in TFM).

= *Trametes* spp.

The type is thin, flabelliform and sterile and in general in bad condition. No reliable conclusion can be reached as to its true identity and the name should be dropped from consideration as a nomen ambigum.

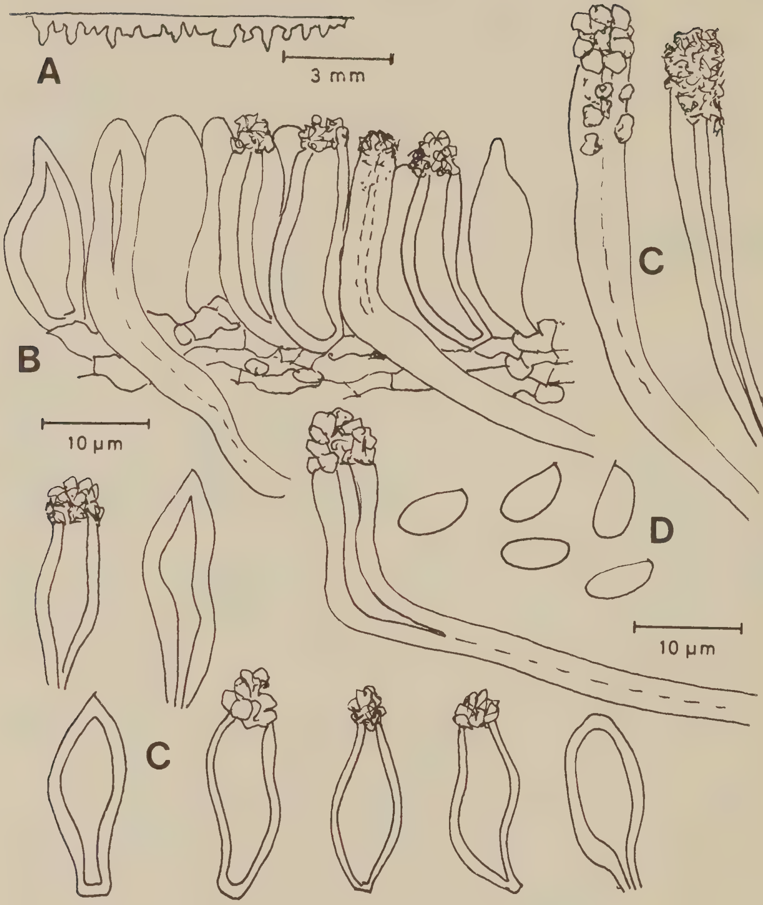
A
3 mm
B
10 µm
C
D
10 µm
C

Fig. 6 *Trichaptum parvulus* A) section of basidiocarp, B) section of hymenium with cystidia, C) cystidia, D) basidiospores. From the type.

orientalis, Polystictus Yasuda, Bot. Mag. Tokyo 32:135, 1918.

Sendai, Japan, 15 Sep. 1912, leg. A. Yasuda (lectotype, selected here, TNS-201876).

= *Trametes* cfr. *lactinea* Berk.

Specimens called *Trametes orientalis* (Yasuda) Imaz. in Japan have often a grayish and glabrous pileus, different from the white to pale leather coloured pileus of *T. lactinea,* a species which is fairly widespread in Japan. Cultural studies are necessaryto verify if this is only a form of *T. lactinea.*

parvulus, Irpex Yasuda, Bot. Mag. Tokyo 35:254, 1922.

Sendai, Japan, 1 Oct. 1916, leg. A. Yasuda (lectotype, selected here, TNS-203047, isotype in TFM). (Fig.6).

= **Trichaptum parvulus** (Yasuda) Hattori & Ryvarden comb. nov. Basionym as cited above.

Basidiocarp annual, resupinate, adnate but margin slightly lifted in dry condition, margin narrow to lacking; hymenophore ochraceous to pale brown with a distinct pale pink hue, irpicoid to hydnoid and crowded with flattened spines, 2-3 per mm, up to 1 mm long, subiculum 0.3 mm thick, dense and cartilaginous as the spines in dry condition.

Hyphal system dimitic, generative hyphae hyaline, with clamps, 2-4 µm wide, skeletal hyphae dominating in the basidiocarp, hyaline, thick-walled to solid, 3-6 µm wide, hymenial cystidia very abundant, ventricose to cylindrical, thick-walled and most of them with an apical encrustation, 10-15 x 4-6 µm; present also in the hymenium are skeletal cystidia arising deep in the central part of the spine as skeletal hyphae and bending into the hymenium as cystidia, often with apical encrustation; basidia not seen, spores hyaline, thin-walled, smooth, negative in Melzer's reagent, ellipsoid, 6-7 x 3 µm. Type of rot unknown, on hardwoods, the type was collected on *Lespedezia burgeri* Mich. (Fabaceae).

Besides the type, also the following collection was examined: Japan, Chiba Prefecture, Kiyosumi Forest Sta, Tokyo University Forest. 24. August 1983. L. Ryvarden 20866 (O and TKB).

Maas Geesteranus (1974:493) has commented upon the status of this species and pointed out the resemblance to *Steccherinum* although he felt the structure and shape of the spines excluded the species from that genus. We feel that the species belongs in *Trichaptum* because of the irregular hymenophore, also seen in *T. fuscoviolaceus*, the cartilaginous consistency which is so typical for many *Trichaptum* species and numerous small ventricose to clavate apically encrusted cystidia, a feature seen in many *Trichaptum* species. The spores come close to those of *T. byssogenus*, but are slender and basidiocarps of that species normally are poroid and pileate and when resupinate, are pale umber brown, and have much larger pores which however may split. its configuration is thus grossly different from the species discussed here.

purpureus, Irpex Yasuda ex Lloyd, Mycol. Writ. 5:715, 1917.

Mt.Iwaya, Iyo, Japan, 19 Oct. 1916, leg. M. Komatsuzaki (lectotype selected here, BPI-USO325519).

= *Australohydnum dregeanum* (Berk.) Hjorts. & Ryv. (basionym *Corticium*

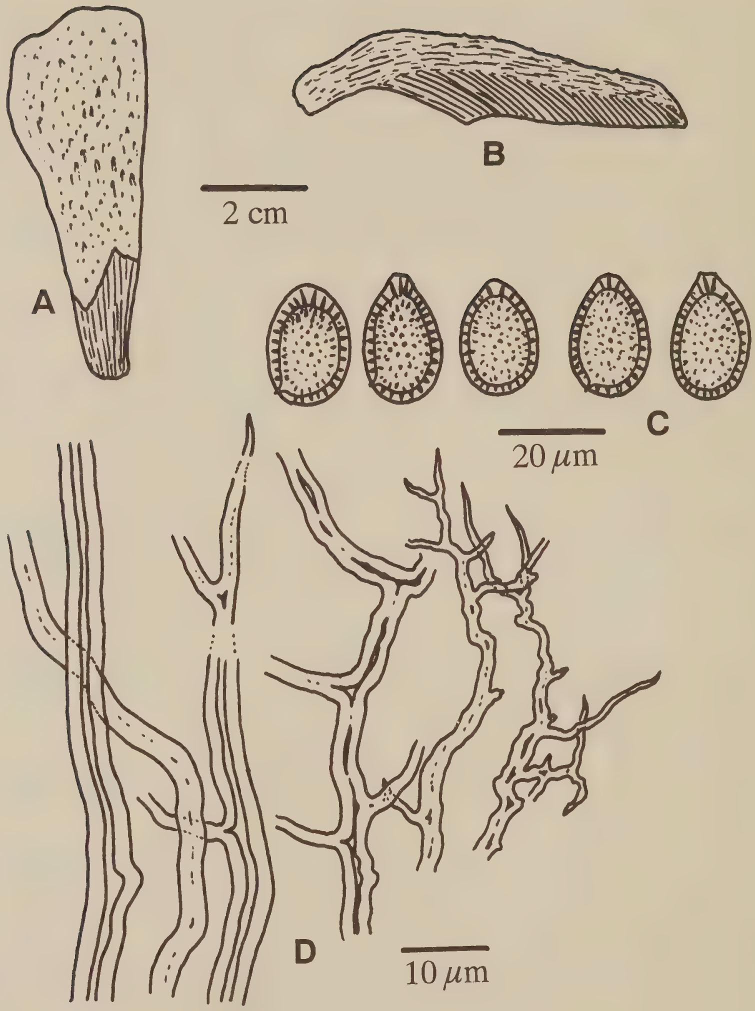
A
B
2 cm
C
20 μm
D
10 μm

Fig. 7. *Ganoderma tsunodae* A) basidiocarp, B) section of basidiocarp, C) basidiospores, D) contextual vegetative hyphae. From the lectotype.

dregeanum Berk., K!). For a detailed description of this species, see Hjortstam & Ryvarden (1990).**pusilla, Coltricia** Imaz. & Ysk. Kobayashi, Trans. Mycol. Soc. Japan 7:42, 1966.

Kiyomizu, Kyoto, Japan, 18 Aug. 1991, leg. T. Hattori, (neotype, selected here TNS, isotype in TFM, O).

= **Coltriciella pusilla** (Imaz. & Ysk. Kobay.) Corner

This species is remarkable by its spatulate and laterally stipitate basidiocarp. For a detailed description, see Imazeki & Kobayashi (1966). A coloured picture is provided in Imazeki & Hongo (1989).

It should be noted that the macroscopical characters of this species are identical with those of the *C. dependens* (Berk. & Curt.) Murr., which however, has a pendent basidiocarp. Cultural studies are desirable to ascertain their status.

Morphologically we are convinced that they represent two independent species as no intermediate forms have ever been collected. Further, the upper surface of *C. dependens* is velutinous and usually with hairs on stipe in fresh condition, while it is glabrous and shiny in *C. pusilla*. The context in *C. dependens* is fibrous-spongy and very light in weight in dried condition while it is leathery in *C. pusilla* as for example in *Coltricia cinnamomea*.

sciurinus, Inonotus Imaz., Bull. Tokyo Sci. Mus. 6:106, 1943.

Nikko, Totigi, Japan, 7 Nov. 1938, leg. R. Imazeki (type TNS- 206965, isotype in TFM).

= *Inonotus flavidus* (Berk.) Ryv. (basionym *Polyporus flavidus* Berk., K!).

The species is characterized by a thin black line in the duplex context, a thick tomentum, small cylindrical spores and presence of scattered hymenial setae. Besides Japan, it is widespread in the Himalayas.

sendaiensis, Polyporus Yasuda, Bot. Mag. Tokyo 37:101. 1923. Sendai, Japan, 21 Sep. 1913, leg. A. Yasuda (type TNS, isotype in TFM).

= **Pyrroderma sendaiense** (Yasuda) Imazeki,

For a detailed description, see Imazeki (1966) and Ryvarden (1991) with a key to accepted species in the genus.

sendaiensis, Trametes Yasuda, Bot. Mag. Tokyo 36:21, 1922.

Sendai, Rikuzen (Miyagi), Japan, 11 Aug. 1921, leg. A. Yasuda (lectotype, selected here, TNS, isotype in TFM).

= *Datronia stereoides* (Fr.) Ryv.

symploci, Trametes Yasuda, Bot. Mag. Tokyo 37:84, 1923.

Bessho, Yahara, Prov. Hitachi (Ibaraki pref.) Japan, 17 Oct. 1918, leg. Y. Irie (lectotype, selected here, TNS)

As already pointed out by Yasuda himself in the original description (1923), this name is a later synonym of *Perenniporia minutissima* (Yasuda) Hatt. & Ryv.

subumbraculum, Ganoderma Imaz. Bull. Tokyo Sci. Mus. 1:38, 1939.

Hane-yama, Koti, Japan, Sep. 1908, leg. K. Ogawa (holotype, TNS- 206977). The species is apparently a member of the *Ganoderma lucidum* complex. This complex is in a taxonomic chaotic state, and thus, for the time being, we leave the species under

Imazeki's name.

The species is known only from the type. The most striking character are the centrally stipitate basidiocarp, the light- coloured context with 3 layers, and the light weight in dried state. Fig. 7.

tabacinoides, Irpex Yasuda, Bot. Mag. Tokyo 34:96, 1920.

Prov. Harima, Kashima-mura, Ibo-gori, 2 Aug. 1918, on *Pasania cuspidata* (Thunb.) Oerst. (= *Castanopsis cuspidata* (Thunb.) Schottky), leg. U. Ouye (Lectotype selected by Ryvarden (1982), TNS-204262).

= **Hydnochaete tabacinoides** (Yasuda) Imaz.

For a detailed description, see Ryvarden (1982).

tsunodae, Polyporus Yasuda ex Lloyd, Mycol. Writ. 5:792.

Ikeda, Kozuke, Japan, 8 July 1917, leg. K. Tsunoda, (lectotype selected here, BPI-US0307263).

= **Ganoderma tsunodae** (Yasuda ex Lloyd) Trott.

Basidiocarp sessile, single, annual; pileus dimidiate, flabelliform to spatulate, applanate, 3-12 cm long, 3-6.5 cm wide, 1.5-3 cm thick; pilear surface dark cinnamon to ochraceous, coarse, glabrous; tubes sordid white, up to 15 mm deep; pore surface white, pores round to angular, 4-5/mm; context white, fibrous-corky and very rigid when dry (watery-fibrous when fresh).

Hyphal system di-trimitic; contextual generative hyphae not seen in the type; contextual skeletal-binding hyphae hyaline, thick-walled to almost solid, occasionally to conspicuously branched; tramal hyphae as in context; basidia not seen; basidiospores ellipsoid to truncate, pale yellow, wall two layered with interwall pillars, 20-24 x 14-16.5 µm (Fig.8).

This species is remarkable in Ganodermataceae with its white, watery context and large and yellow spores. Macroscopically it reminds remarkably about *G. colossus* (Fr.) Baker, which however has smaller spores (14-19 x 8-12 µm).

Imazeki (1939) proposed *Trachyderma* for *G. tsunodae*. However, the generic name is illegitimate as a homonym of *Trachyderma* Norm. 1853 as pointed out by Ryvarden (1991). On the other hand, *G. colossus* is the type species of *Thomophagus* Murr. 1905. Thus, should it ever be desirable to place these two species in a genus of its own due to their loose and soft consistency, the latter name is available.

yamanoi, Cryptoderma Imaz., Forsch. Geb. Pflanzenkrankh. 4:176, 1951.

Iburi, Lakeside of Sikotu, on *Picea jezoensis* (Sieb. & Zucc.) Carrié, 10 Sep. 1948, leg. R. Imazeki (type, TFM-F-1134, isotype in TNS).

= *Phellinus pini* (Fr.) Quèl., as already pointed out by Imazeki & Hongo (1989). Cerny (1985) concluded that *Phellinus vorax* (Hark.) Cerny is distinct from *P. pini* with a different ecological niche and morphology. If *P. vorax* is accepted as an independent species, *C. yamanoi* is a synonym of this species.

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THE SPECIES OF THE GENUS *RINODINA* (LICHENIZED ASCOMYCETES, PHYSCIACEAE) CONTAINING PANNARIN IN EURASIA WITH A SPECIAL NOTE ON THE TAXONOMY OF *RINODINA GRANULANS*

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ABSTRACT: Six species of the genus *Rinodina* with thalli and/or discs PD+ orange due to the presence of pannarin are hitherto recognized in Eurasia. One is saxicolous, *R. santorinensis*, and five are corticolous, *R. dalmatica*, *R. efflorescens*, *R. excrescens*, *R. granulans* and *R. pruinella*. Notes on the taxonomy of *R. granulans* are provided. Descriptions and illustrations of this species and the also poorly understood *R. excrescens* are included. A key to the treated species is given. Other known species containing pannarin are briefly discussed.

INTRODUCTION

The treated species are specially characterized by the content of pannarin. This lichen substance is usually concentrated in the thallus, in the thalline exciple and/or in the epihymenium which appear entirely interspersed with irregularly shaped and sized crystals. These crystals are clearly visible under polarizing light and dissolve after treatment with PD forming reddish-orange acicular crystals.

Depending on several characters the treated species can be included in four different groups:

Rinodina efflorescens, *R. excrescens* and *R. granulans* are very closely related. They have in common the following characters: (1) pannarin as a principle lichen substance concentrated in the thallus, the thalline exciple and the epihymenium; (2) a well developed thallus, composed of scattered to contiguous areolae, appearing as minute flattened squamules which dissolve into soredia or blastidia; (3) an epihymenium with a granular and PD+ orange epipsamma (pannarin); (4) thalline exciple reacting I+ blue (5) asci of the *Lecanora*-type (Honegger 1978) and (6) ascospores of the *Physcia*-type with tendencies to the *Milvina*-type.

Rinodina dalmatica is separated from the first group only because of the *Pachysporaria*-type ascospores.

Rinodina pruinella differs from the species cited above in the following characters: (1) pannarin located only in the epihymenium. Atranorin constitutes the principle lichen substance; (2) thallus not composed of areolae and not developing vegetative propagules; (3) thalline exciple I- and (4) ascospores of the *Dirinaria*-type.

Lastly, *Rinodina santorinensis* s. lat. is distinguished by: (1) pannarin present only in the thallus and the thalline margin; (2) epihymenium PD-, without epipsamma and (3) habitat saxicolous and usually parasitic.

According to Sheard (in lit.), the literature checked and our own investigations, other species hitherto described possessing pannarin but not present in the study area are: the saxicolous *Rinodina murrayii* H. Mayrhofer, from Australasia, and the corticolous *R. adirondackii* H. Magn., *R. granuligera* H. Magn., *R. marysvillensis* H. Magn. and *R. thujae* (H. Magn.) Sheard, all from North America. Complete descriptions of these species are given by Mayrhofer (1983) and Magnusson (1932, 1947b and 1953).

R. murrayii belongs to the same group that *R. excrescens*, *R. granulans* and *R. efflorescens*, but the thallus does not develop vegetative diaspores and is saxicolous. *R. adirondackii*, like *R. dalmatica*, is separated by its *Pachysporaria*-ascospores, but its thallus does not develop vegetative propagules. *R. granuligera* and *R. marysvillensis* are closely related to *R. pruinella* but their ascospores belong to the *Physcia*-type.

We cannot exclude the possibility that other pannarin containing species may exist because the PD reaction was often not checked by other authors.

The terminology employed for the vegetative propagules follows that of Poelt (1980), Hawksworth et al. (1983) and Fox & Purvis (1992), for the ascospores Mayrhofer (1982) and Scheidegger (1993) and for the asci Honegger (1978). For the identification of lichen substances the standardized methods for thin layer chromatography (TLC) were used (e.g. Culberson & Ammann 1979).

KEY TO THE SPECIES

1a Saxicolous. **2**
1b Corticolous or lignicolous. **3**

2a Epihymenium PD-. Ascospores *Pachysporaria*-type with tendencies to *Physcia*-type, 14-22 x 7-14 µm. Thallus parasitic or seldom autotrophic. Macaronesia and mediterranean region. ***R. santorinensis***
2b Epihymenium PD+ orange. Ascospores *Physcia*-type, 16-22 x 10-13 µm. Thallus always autotrophic. Australasia. *(R. murrayii)*

3a Thallus lacking of vegetative propagules, PD+ faint yellow. Ascospores *Dirinaria*-type, 15-25 x 7-13 µm. Maritime, southern mediterranean-atlantic. ***R. pruinella***
3b Thallus servediate or blastidiate, PD+ orange. Ascospores different. **4**

4a Thallus sorediate. Soralia discrete, never forming a continuous leprose crust. Ascospores *Physcia*-type, 15-20 x 7-10 µm. Oceanic, boreal and suboreal. ***R. efflorescens***
4b Thallus blastidiate. Blastidia forming a more or less continuous granulose-isidiose or leprose crust. **5**

5a Blastidia large, up to 60-80(-100) µm diam., forming a granulose-isidiose crust (appearing subsquamulose). Ascospores *Physcia*-type, 14-21 x 7,5-11 µm. Boreal, subboreal and mediterranean ***R. excrescens***
5b Blastidia small, up to 30 µm diam, forming a continuous leprose crust. **6**

6a Ascospores *Pachysporaria*-type, when young with polygonal lumina, 17-26 x 8-13 µm. Maritime, mediterranean-atlantic. ***R. dalmatica***
6b Ascospores *Physcia*-type, when young never with polygonal lumina, 18-25 x 10-14 µm. Siberia. ***R. granulans***

THE SPECIES

1) *RINODINA DALMATICA* ZAHLBR.

Österr. Bot. Z. **51**: 348 (1901); BOULY DE LESDAIN (1909: 170); HARMAND (1913: 902); MAGNUSSON (1947a: 313); GIRALT et al. (in prep.).
Type: **Croatia**: Dalmatia, "in peninsula Lapad prope Ragusa", 100 m, on *Pinus halepensis*, J. BAUMGARTNER (GZU, W, WU-isotypes).
Exs.: ZAHLBRUCKNER: Lich. rar. exs. 39 (GZU, W, WU).

Rinodina dalmatica is distinguished by the entirely blastidiate thallus forming a continuous leprose crust and the *Pachysporaria*-type ascospores, when young with typical polygonal lumina. It is unique amongst *Rinodina* species in having the latter feature.

Selected specimens examined: CROATIA: Dalmatia: Ragusa, Mte. Petka, 150 m, on *Pinus halepensis*, A. LATZEL (W). - **GREECE**: Korfu: Kerkyra, NW Ipsos, on *Olea*, 16-17.8.1970, J. POELT (GZU). - Peloponnes: Elis, Olympia, on *Pinus halepensis*, 14.4.1971, J. POELT (GZU). - **ITALY**: Latium: Roma, Tenuta di Caccia di Castel Porziano, SW Roma, 0-20 m, 8.5.1986, J. POELT (GZU). - **PORTUGAL**: Algarve: Sierra de Monchique, Caldas, Vale do Paraiso, on *Olea europaea*, 24.2.1946, C.N. TAVARES & L. SOBRINO (LISU). - Estremadura: Setúbal, Mata do Reboredo, on *Pinus halepensis*, 14.5.1944, C.N. TAVARES (LISU).

2) *RINODINA EFFLORESCENS* MALME

Svensk Bot. Tidskr. **21**: 251 (1927); MAGNUSSON (1947a: 229); HARRIS (1977: 129, as *Rinodina* sp. 1, according to SHEARD in lit.); COPPINS & JAMES (1979: 175); WITTMANN & TÜRK (1987: 394); DIEDERICH (1989: 204); ETAYO (1992: 192); FOX & PURVIS (1992: 548); TØNSBERG (1992: 286); WIRTH (1990: 328); WONG & BRODO (1990: 364, 1992: 70); GIRALT et al. (1993: in press.).
Type: Sweden: Västergötland, Habo, St. Kärr, on old *Fagus* in a shady place, 1923, G.O. MALME (S - not seen).
Syn.: *Rinodina hueiana* (HARM.) OLIV., *Bull. Acad. Internat. Geogr. Bot.* **15**: 211 (1905). - *Lecanora hueiana* HARM., *Bull. Soc. Sci. Nancy, ser. 2,* **15**: 195 (1898); HARMAND (1913: 883). - non *Rinodina hueana* VAIN., *Hedwigia* **37**: 38 (1898). - **Type**: **France**: Vosges, "en montant au Ballon d'Alsace depuis Saint Maurice, sur un Bouleau, parasite sur le thalle vieux du *Parmelia saxatilis*", HARMAND (ANGUC - not seen).
Discussion: The incorrectly spelled epithet *hueiana* [see recommendation 73C(c) of the I.C.B.N.] is only an orthographic variant of *hueana* and the combination *Rinodina hueiana* proposed by OLIVIER (loc. cit.) is a latter homonym of *Rinodina hueana* VAIN. DIEDERICH (1989) already listed *R. hueiana* as a synonym of *R. efflorescens.* WIRTH (1990) placed *R. efflorescens* in the synonymy of *R. hueiana* without further comments. Because of the mentioned criteria *R. efflorescens* is the correct name of this species.

Exs.: Lich. sel. exs. Upsalienses 71 (GZU).

The discrete soralia are diagnostic of *R. efflorescens.*

Selected specimens examined: **AUSTRIA**: Steiermark: Nördliche Kalkalpen, ca. 3 km W of Großreifling, ca. 640 m, on *Acer* sp., 26.10.1990, J. POELT, J. HAFELLNER & E. LOPEZ DE SILANES (GZU). - **BRITISH ISLES**: Isle of Wight: Bortheood Copse, on *Quercus*, November 1977, F. ROSE (BM). - Main Argyll: Seil, Ballachuan, Pòrt Mòr, on *Sorbus aria*, 5.8.1980, P.W. JAMES (BM). - East Sussex: Eridge Old Park, on old oak, June 1968, F. ROSE & P.W. JAMES (BM). - **FRANCE**: South-Voges: Steinbach, Cernay, ca. 700 m, on *Quercus petraea*, 27.10.1968, V. WIRTH (STU). - **GERMANY**: Württemberg: Neckar, Leonberg, Warmbronn, Stöckach, 440 m, 16.10.1988, V. WIRTH (STU). Baden, Südschwarzwald, Schönau, 600 m, 30.9.1971, V. WIRTH (STU). - **SPAIN**: Navarra: Belabarce, 1100 m, on *Fagus sylvatica*, 25.7.1987, J. ETAYO 3313 (Etayo).

3) *RINODINA EXCRESCENS* VAIN.

Ann. Acad. Sci. Fenn., Ser. A, **27**: 84 (1928); MAGNUSSON (1947a: 237); GIRALT et al. (1993: 711).
Type: **Siberia** :"Sibiria Occidentali, Konda, ad lignum putridum in pineto prope Leunsk", 1880, E. VAINIO (TUR-V 08798-holotype).

Thallus (Figs. 1c; 2a,b) crustaceous composed of scattered to contiguous areolae. Areolae light grey to grey brown, plane to bullate, 0,1-0,5 mm diam., with the appearance of minute sublobate squamules, becoming more or less confluent, mostly developing ascending blastidia. *Blastidia* large, 60-100 μm diam., scattered or confluent and then forming a continuous granulose-isidiose crust, concolorous with areolae. *Apothecia* (Figs. 1c; 2a) rare, sessile, scattered or contiguous, up to 1 mm. Thalline margin concolorous with thallus, at first thick, entire and prominent, becoming thinner and flexuose, often partially excluded. Disc plane, rarely convex, brown, slightly pruinose. Proper margin often visible as a ring within the thalline margin. *Excipulum thallinum* up to 80 μm laterally, expanded to 100-110 μm below, I+ blue, inspersed with crystals of pannarin. Cortex cellular, 15-20(-40) μm laterally, expanded to 40-60 μm below, cells thin-walled. *Excipulum proprium* 10-15 μm laterally, expanded to 25-40 μm above. *Epihymenium* reddish-brown, with a granular and PD+ orange epipsamma. *Hymenium* (60-)80-100 μm high. *Hypothecium* colourless 40-110 μm deep. *Paraphyses* ca. 1,5-2 μm wide, apices capitate, 2,5-3,5 μm wide. *Asci* 8-spored, *Lecanora*-type. *Ascospores* (Figs. 2c-e) *Physcia*-type, (15-)17-19(-21) x (7,5-)9-10(-11,5) μm, smooth (someones when overmature minutely warted), constricted at the septum, with a well developed torus (Fig. 2e). *Spermatia* not seen.
Chemistry: Thallus K+ yellow and PD+ orange; pannarin and atranorin by TLC.

DISCUSSION: This species is characterized by the thallus composed of discrete to contiguous areolae which partially develop ascending blastidia (isidia-like) and form a more or less continuous granulose-isidiose (appearing subsquamulose) crust (Fig. 2a-b). The large blastidia, up to 100 μm diam., make this species morphologically distinct from its relatives.
Rinodina thujae (H. MAGN.) SHEARD, from North America, is closely related if not conspecific to *R. excrescens*. The holotype differs from the investigated specimens of *R. excrescens* exclusively in the areolae which do not build structures resembling blastidia (compare Fig. 1d and Fig. 2a-b). Another sample of *R. thujae* studied (WETMORE 32864) is somewhat intermediate between both species, with some areolae developing blastidia-like structures (=ascending and sublobate margins). After the study of this sample, and without having seen the holotype, this species was mentioned in GIRALT et al. (1993) as a possible synonym of *R. excrescens*. The study of further North American material of *R. thujae* is necessary in order to solve its taxonomical position definitively.

HABITAT AND DISTRIBUTION: *Rinodina excrescens* has hitherto been reported only from the type locality in West Siberia (VAINIO 1928, MAGNUSSON 1947a) and from Austria (GIRALT et al. 1993). According to SHEARD (in lit.) the record from North America reported by BRODO et al. (1987) and also cited in EGAN (1987) refers to another, undescribed *Rinodina* species.

Additional specimens examined: AUSTRIA: Steiermark: Gurktaler Alpen, Grebenzen, 6 km NW Neumarkt, 1 km NW Oberdorf, Dürnberger Hochmoor, ca. 980 m. on *Juniperus communis*, 20.1.1988, W. OBERMAYER 2587 (GZU, Obermayer). Weststeirisches Hügelland, zwischen Deutschlandsberg und

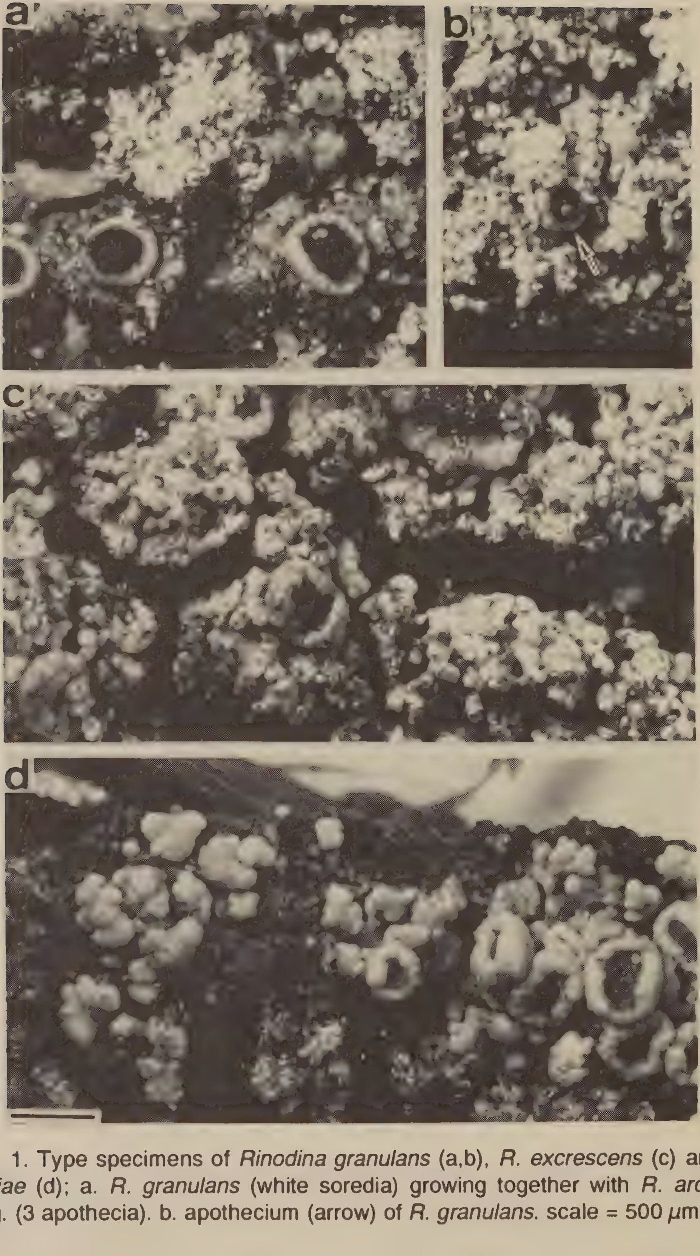

Fig. 1. Type specimens of *Rinodina granulans* (a,b), *R. excrescens* (c) and *R. thujae* (d); a. *R. granulans* (white soredia) growing together with *R. archaea* agg. (3 apothecia). b. apothecium (arrow) of *R. granulans*. scale = 500 µm.

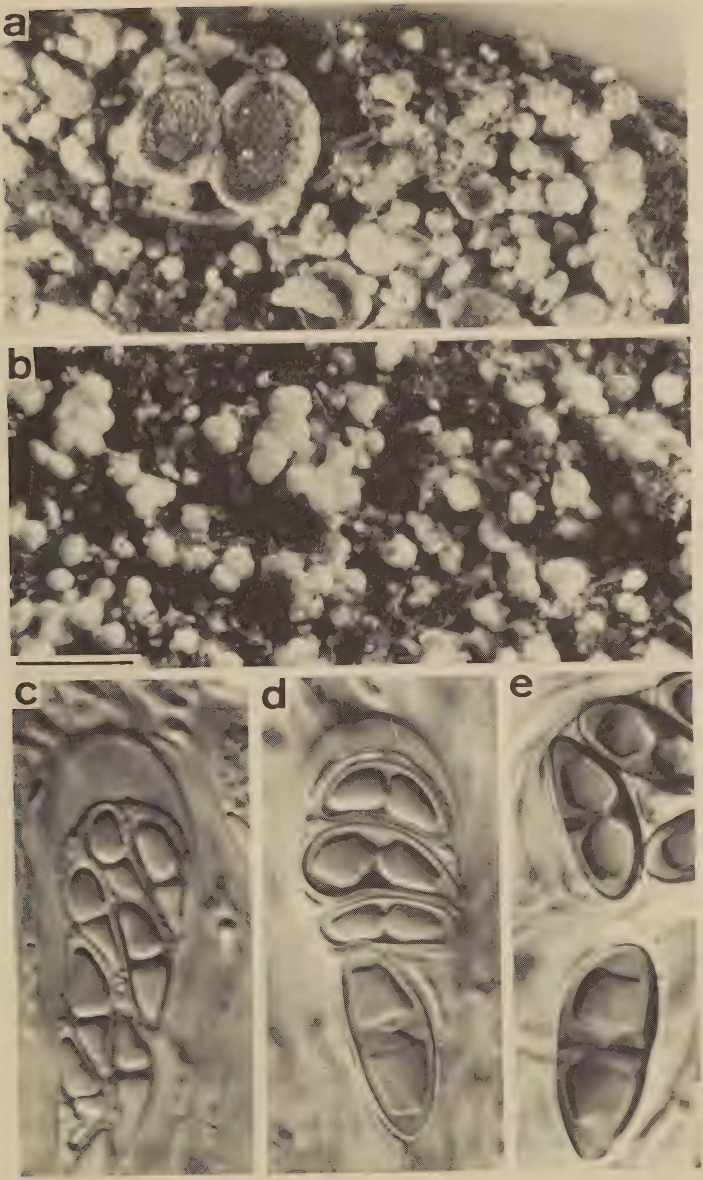

Fig. 2. *Rinodina excrescens* (OBERMAYER 2587). a. apothecia. b. blastidiate areoles. scale = 500 µm. c-e. ascospore ontogeny (*Physcia*-type ascospores). scale = 10 µm.

Schwanberg, ca. 390 m, on *Quercus robur*, J. HAFELLNER 23250 & M.E. LOPEZ de SILANES (GZU, Hafellner). - **CROATIA**, Insel Mljet, S Veliko Jezero, 0-30 m, on *Pinus halepensis,* 15.04.1979, O. BREUSS 954 (Breuß).

4) *RINODINA GRANULANS* VAIN.

Ann. Acad. Sci. Fenn., Ser. A, **27**: 83 (1928)
Syn.: *R. sibirica* var. *granulans* (VAINIO) H. MAGN., *Acta Horti Gothob.* **17:** 272 (1947a). - **Type**: **Siberia**: "Sibiria Occidentali, Konda, in saepimento ligneo loco umbroso ad Tumynvatsk", 1880, E. VAINIO (TUR-V-08799 - holotype)

Thallus (Figs. 1a-b) crustaceous, composed of scattered to contiguous areolae. Areolae whitish, whitish-grey, whitish-green or brownish, matt, plane or slightly convex (0,1-)0,2-0,3(0,5) mm diam., usually becoming confluent, with the appearance of minute squamules, dissolving completely into small blastidia. *Photobiont* trebouxioid, cells 7-12(-15) mm diam. *Blastidia* small, 15-30(-50) μm diam., confluent, forming a continuous leprose crust, whitish (in the holotype) or with a ±dark brown tinge (in the other specimens examined), budding from the margins and surfaces of the areolae. *Apothecia* very rare, sessile or innate in a dense layer of blastidia, constricted at the base, up to 0,3 mm diam. (all of them are very young). Thalline margin persistent, smooth, concolorous with the areolae. Disc plane, reddish-brown. *Excipulum thallinum* 80-90 μm laterally, expanded to 130 μm below, I+ blue, inspersed with crystals of pannarin. Cortex cellular, 10-15 μm laterally, 30-50 μm at the base, cells thin-walled. *Excipulum proprium* indistinct laterally, expanded to 30-50 μm above. *Epihymenium* reddish-brown, with a granular and PD+ orange epipsamma. *Hymenium* 70-80 μm tall. *Hypothecium* colourless, ± 100 μm deep. *Paraphyses* 1,3-2 μm wide, apices capitate, 2,5-4 μm. *Asci Lecanora*-type. *Ascospores Physcia*-type with tendencies to *Milvina*-type, constricted at the septum, smooth, with a well developed torus, 18-25 x 10-14 μm. *Spermatia* not seen.
Chemistry: Thallus K+ faint yellow and PD+ orange; pannarin by TLC.

DISCUSSION: In the sample of the holotype of *R. granulans* there are two *Rinodina* species growing together (Fig. 1a). One species has a thallus consisting of discrete to contiguous areolae dissolving completely into small blastidia and forming a continuous leprose crust. This thallus contains pannarin (PD+ orange) and includes only very few apothecia, mostly very young and hidden between the blastidia. The excipulum thallinum is I+ blue and entirely inspersed with crystals PD+ orange (pannarin); the epihymenium is covered with a granular epipsamma, not dissolving in K and also PD+ orange; and the ascospores are *Physcia*-type, with tendencies to *Milvina*-type, with walls irregularly thickened.
The second species has a thin, smooth and continuous thallus without positive reactions. The apothecia are abundant and very well developed. The excipulum thallinum is I- and without any crystals; the epihymenium is covered with a coarsely granular epipsamma dissolving in K and PD-; and the

ascospores are *Physconia*-type, 18-21 x 8,5-10 µm, with uniform walls (SCHEIDEGGER 1993). This species belongs to the *Rinodina archaea* group.
VAINIO's original description includes characters of both species. Whereas the description of the thallus is based on the first species: "*Thallus verruculoso-rugulosus, ...**verruculis dispersis aut contiguous**, p. p. **soredioso**-fatiscentibus, **farinosam** confluentibus ......*", the description of the apothecia fits with the second one: "***Apothecia in partibus minus servediosis thalli sat crebre evoluta**..... Margine tenui, integro.... **Excipulum** ....., **jodo non reagens**..... **Sporae** long 0,017-0,021, crass 0,09-0,011 mm, **membrana sat aequaliter incrassata**......*".
According to the I.C.B.N. (art. 9.2, rec. 7B) we choose the species characterized by an entirely blastidiate and PD+ orange thallus and *Physcia*-type ascospores, as the lectotype of *R. granulans*.

Rinodina granulans is characterized by its small blastidia (soredia-like) forming a continuous, ±brownish leprose crust and its *Physcia*-type ascospores grading into the *Milvina*-type. Apothecia were observed only in the type material (Fig. 1b).

HABITAT AND DISTRIBUTION: *Rinodina granulans* seems to be a widely distributed and quite common species in Siberia where it grows mostly on lignum and on small dry twigs, more seldom on smooth bark, associated with other lignicolous species such as *Rinodina archaea* agg., *Candelariella vitellina*, *Lecanora symmicta* and *L. varia*. Other associated species are: *Melanelia olivacea* coll., *M. exasperatula*, *Parmelia sulcata*, *Xylographa parallela*, *Cyphelium tigillare*, *Hypocenomyce scalaris*, *Calicium salicinum* and *Caloplaca cerina*.

Additional specimens examined: SIBERIA: Jenisejsk, Nasimova, on lignum, 28.6.1876, M. BRENNER (S). Jenisejsk, near the city of Jenisejsk, on lignum, 21.6.1876, M. BRENNER (S). Jenisejsk, Verst, N of Jenisejsk, on old cortex of *Prunus padus*, 26.6.1876, M. BRENNER (S). Jenisejsk, Novo Sjolovskoje, on lignum, 26.9.1876, M. BRENNER (S). Jenisejsk, Troitskij Klosterdorf, on lignum, 13.7.1876, M. BRENNER (S). Jenisejsk, Potkamina Tanguska, on lignum, 28.9.1876, M. BRENNER (S). Jenisejsk, Asinovo, on dry twigs, 4.7.1876, M. BRENNER (S). Jenisejsk, Vorogova on lignum, 30.9.1876, M. BRENNER (S). Tobolsk, Kalimski, on lignum, dry twigs and *Betula* sp., 31.5.1876, M. BRENNER (S). Tomsk, Timskaja, on dry twigs, 1.6.1876, M. BRENNER (S).

5) *RINODINA PRUINELLA* BAGL.

Nuovo Giorn. Bot. Ital. **11**: 79 (1879); complete information about this species is given by GIRALT & MAYRHOFER (1994).
Type: Italy: Sardinia, Giorgino iuxta Cagliari, on *Ficus carica* CANEPA (MOD-holotype).
Exs.: SAMPAIO: Lich. de Portugal 192 (M, UPS).

Pannarin located only in the epihymenium, together with the thallus lacking of vegetative diaspores and K+ yellow (atranorin) and the *Dirinaria*-type ascospores, are diagnostic for this species.
Among the species containing pannarin, *R. pruinella* and the North American *R. granuligera* and *R. marysvillensis* are unique in having this substance concentrated only in the epihymenium rather than in the thalline and other apothecial tissues. This feature easily separates these taxa from their relatives. *R. granuligera* and *R. marysvillensis* cannot be mistaken for *R. pruinella* because of their *Physcia*-type ascospores (see below).
The examined specimens are listed in GIRALT & MAYRHOFER (1994)

6) *RINODINA SANTORINENSIS* J. STEINER s. lat.

Verh. Zool.-Bot. Ges., Wien **69**: 55 (1919); a complete information about this species is given by MAYRHOFER et al. (1993).
Type: **Greece**: Santorin Island, between Thira and Pyrgos, 4.1911, R. WETTSTEIN (W-lectotype).
Exs.: FOLLMANN: Lich. sel. exs. 219 (B, GZU, H, LD, W, as *R. confragosa*). - Plantae Graecenses, Lich. 504 (GZU). - VEZDA: Lich. rar. exs. 39 (ANUC, BM, DUKE, GZU, H, HO, M, PRM, STU, TSB, UPS, VBI, Kalb, Lumbsch and Vezda).

Rinodina santorinensis and the Australasian *R. murrayii* are the only saxicolous species hitherto known containing pannarin. For this reason the latter is also mentioned in the key. The PD- and I- reactions at the epihymenium and excipulum level, respectively, distinguish *R. santorinensis* not only from *R. murrayii* but also from the other treated species. On the other hand, the epihymenium lacking pannarin and the *Pachysporaria*-type ascospores show that *R. santorinensis* is more closely related to *R. beccariana* and to the corticolous *R. roboris* (MAYRHOFER et al. 1993) than to the taxa treated in this contribution.

The specimens examined are listed in MAYRHOFER et al. (1993).

OTHER *RINODINA* SPECIES CONTAINING PANNARIN NOT PRESENT IN THE STUDY AREA

Rinodina adirondackii **H. MAGN.**, *Bot. Not.*: 48 (1947b). - **Type**: U.S.A.: New York, Adirondack Mountains, Chapel Pond, near St. Huberts, 1600ft, on cedar in gully, 1933, J.L. LOWE (UPS-holotype, not seen).
This species is distinguished by the thallus lacking vegetative propagules and the large *Pachysporaria*-type ascospores, 21-35 x 15-21 µm. *Rinodina dalmatica* and *R. santorinensis* possess the same ascospore-type but in both species those are smaller. Furthermore *R. dalmatica* has a blastidiate thallus and *R. santorinensis* is saxicolous.

Distribution: Limited to America's northeastern states, Ontario and Quebec (SHEARD in lit). No specimen belonging to this species has been investigated. All information was provided by Dr.Sheard (Saskatoon).

Rinodina granuligera **H. MAGN.**, *Bot. Not.*: 35 (1947b). - **Type**: U.S.A.: Florida, Sanford, on trees, 1909, RAPP (UPS-holotype, not seen).
Pannarin located only in the epihymenium, together with the thallus lacking vegetative diaspores, K+ yellow (atranorin) and the *Physcia*-type ascospores of 15-18 x 6,5-8,5 µm, distinguish this species from its relatives (see also *R. pruinella*).
Distribution: Southern and Eastern North America (SHEARD in lit.).
Specimens examined: **U.S.A.:** Louisiana: Baton Rouge, N of Terrebonne-Lafourche parish line on road 309, west of Thibodaux, on Salix, 11.10.1980, S.C. TUCKER (GZU). 4,7 miles n-NE of Chipola, on gravel road (Parrish road 1044), hardwood forest in ravine, 8.3.1973, S.C. TUCKER 11101B (Sheard). West Side of lake Bistineau, on dirt road parallel to lake edge, immature mixed *Pinus* sp.-*Quercus ilex* forest, 26.5.1973, S.C. TUCKER (Sheard).

Rinodina marysvillensis **H. MAGN.**, *Ann. Cryptog. Exot.* **5**: 31 (1932). - **Type**: U.S.A.: Washington, Marysville, on *Salix* bark, 1927, GRANT (UPS-holotype).
The same characters cited for *R. granuligera* distinguish *R. marysvillensis* from the treated species. Both species are closely related but they can be mainly separated by the different ascospore size and shape being for *R. marysvillensis* larger [(16-)18-22 x (8-)10-11(-13) µm] and more broadly ellipsoid. Their distribution it is also markedly different (see also *R. granuligera* and *R. pruinella*).
Distribution: Western North America (SHEARD in lit.).
Additional specimens examined: **U.S.A.**: California: Amador Co., on *Alnus rhombifolia*, riparian woodland along Sutter Creek between Sutter Creek and Volcano, ca. 2000 ft. alt, 15.3.1975, W.A. WEBER (SHEARD, as WEBER: Lich. exs. 474). San Francisco Co., San Francisco, Lands End, NE of Santa Cruz Peninsula, on *Alnus rubra*, 25.6.1974, I.M. BRODO 20481 & R.M. BROWN (CANL).

Rinodina murrayii **H. MAYRHOFER**, *Lichenologist* **15**(3): 273 (1983). - **Type**: New Zealand: South Island, Otago, Lee Stream Valley south west of Dunedin, 2 km north of Lee Stream School, ca. 490 m, 23.9.1981, H. MAYRHOFER 2199 (GZU-holotype; CHR, OTA-isotypes).
The saxicolous habitat together with the *Physcia*-type ascospores make this species distinct from its relatives (see *R. santorinensis*).
Distribution: New Zealand and Australia (MAYRHOFER 1983, 1984).
The specimens examined are listed in MAYRHOFER (1983).

Rinodina thujae **(H. MAGN.) SHEARD**, *Bryologist* **90**: 164 (1987); *R. marysvillensis* var. *thujae* H. MAGN., *Bot. Not.:* 192 (1953).- **Type**: U.S.A.: Wisconsin, Villas Co. Eagle River on *Thuja occidentalis*, 1946, J.W. THOMSON 2122 (UPS-holotype).

Only the larger areolae which do not dissolve into blastidia or soredia distinguish this species from the closely related *R. excrescens* and *R. granulans* (see comments made for these taxa).
Distribution: Great Lakes States and Canada (SHEARD in lit.).
Additional specimens examined: **U.S.A.:** Minnesota, St. Louis Co., Voyageurs National Park, 11.6.1978, C.M. WETMORE 32864 (MIN).

We are indebted to the directors and keepers of the following herbaria: BM, CANL, GZU, LISU, MIN, S, STU, TUR, W and WU; to Dr. O. BREUSS (Vienna), Dr. J. ETAYO (Navarra) and Dr. J. HAFELLNER (Graz) who kindly lent us their private collections; to Mag. M. MATZER (Graz) for selecting specimens in BM; to Prof. Dr. J.W. SHEARD (Saskatoon) for his valuable information and comments on some specimens as well as for the loan of some specimens and correcting the English text and to Prof. Dr. J. POELT (Graz) for critical revision of the manuscript. The second author (H. MAYRHOFER) was supported by the Fonds zur Förderung der wissenschaftlichen Forschung (Projekt P8500-BIO).

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MYCOTAXON

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SYSTEMATIC AND BIOLOGICAL STUDIES IN THE BALANSIEAE AND RELATED ANAMORPHS. VIII. THE EPHELIS ANAMORPH OF BALANSIA EPICHLOE.

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ABSTRACT

The development and morphology of the *Ephelis* state of *Balansia epichloe* (Weese) Diehl on the adaxial surface of leaves of *Eragrostis capillaris* (L.) Nees are described. Differences between the conidiomata of this and those of some other *Balansia* anamorphs are noted. A formal taxonomic description is presented.

INTRODUCTION

As discussed previously (Phelps et al., 1993b), *Ephelis* conidiomata of *Balansia* species vary considerably in morphology, ranging from effuse and ill-defined to distinctly hysteriform or apothecoid. Such structures have been variously referred to as being pycnidial, sporodochium-like, patellate, or cupulate (Diehl, 1950; Ullasa, 1969). Whatever their form, the conidiomata are produced on primary stromata of diverse thicknesses, the latter prosenchymatous to pseudoparenchymatous in texture and developing superficially on host plant surfaces. Primary stromata of the various species differ morphologically, depending upon the plant part on which they are produced. Generally, when occurring on culms as in *Balansia aristidae* (Atk.) Diehl, a pathogen of *Aristida* spp. (Phelps *et al.*, 1993a), and especially on leaves as in *Balansia epichloe*, anamorph stromata are flat and effuse. When associated with inflorescences, as in *Balansia cyperi* Edg. on *Cyperus* spp. and *Atkinsonella hypoxylon* (Peck) Diehl on *Danthonia spicata* (L) P. Beauv. ex Roem. & Schult., *Ephelis* conidiomata are often borne on somewhat pulvinate or cushion-like stromata and are cupulate or patellate in form (Diehl, 1950; Rykard *et al.*, 1984; Leuchtmann and Clay, 1988).

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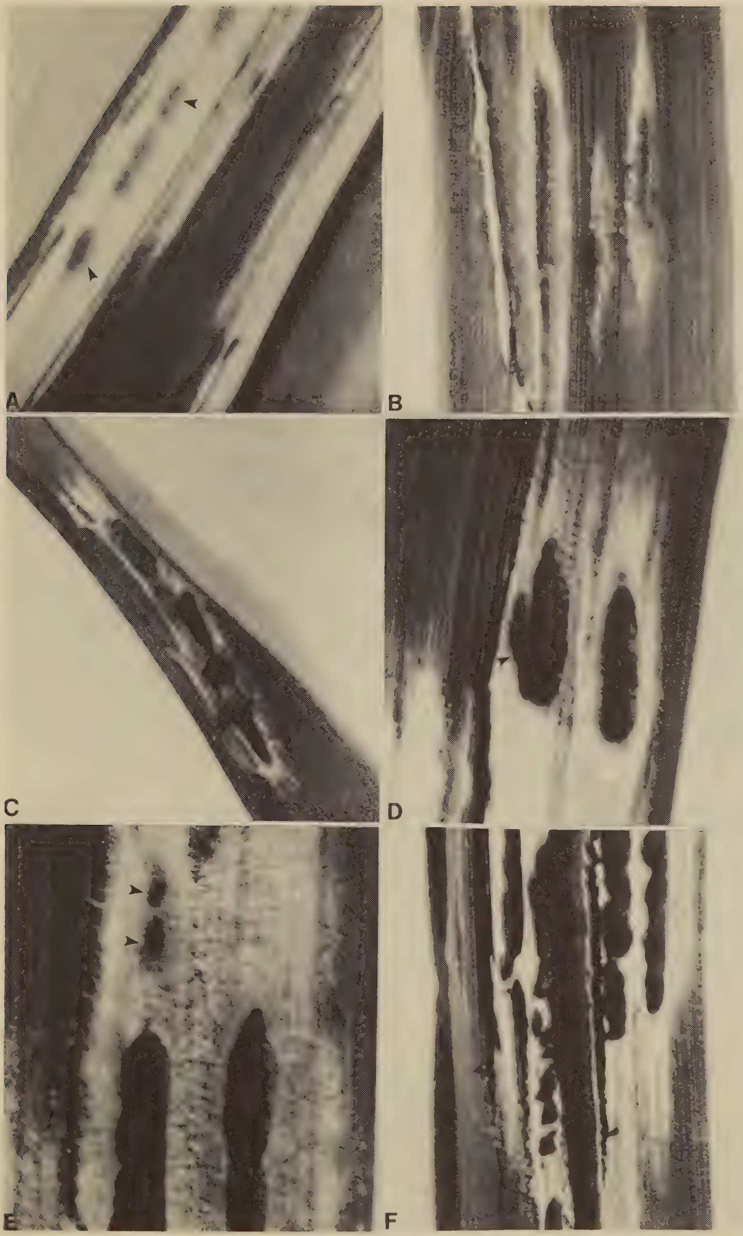
Primary stromata formed on leaves, such as those of *Balansia epichloe* and *B. henningsiana* (Moell.) Diehl, originate from hyphae egressing between epidermal cells or through stomata (Phelps *et al.*, 1993c), and are usually thin, diffuse, often extending and spreading some distance over the surface. These two species, each of which occurs on a number of grass hosts, have often been confused, but differ in that they form ascostromata that are epiphyllous and hypophyllous, respectively. *Balansia henningsiana* occurs commonly in the southern United States on species of *Andropogon* L., and *Panicum* L. (Diehl, 1950). *Balansia epichloe* has a similar geographical distribution and a host range including species of *Eragrostis* Wolf, *Panicum*, and *Sporobolus* R. Br. (Diehl, 1950).

In *B. epichloe*, hyphal egress through the adaxial leaf surface occurs predominantly between epidermal cells and bulliform cells of the longitudinal grooves (Phelps, *et al.*, 1993c). At first, external hyphal proliferation occurs primarily along the length of the longitudinal grooves proximal to the sites of egress. This gives rise to a number of dense, linear mycelial mats in the grooves, interconnected by sparse hyphae overlying the costal regions. Eventually the primary stroma extends more or less evenly over the affected portion of the leaf surface. The *Ephelis* anamorph is formed from this stroma.

Rykard *et al.* (1984) briefly described the conidiomata of *Atkinsonella hypoxylon* and several *Balansia* species, including *B. epichloe* and *B. henningsiana*. Species were found to differ in a number of characteristics, including extent of fertile conidiophore palisade development, thickness and persistence of overlying stromal tissue, presence or absence of distinguishable peripheral excipular tissue and spatial relationship of primary and secondary perithecial stromata. In *B. henningsiana*, collected in Georgia on *Andropogon virginicus* L., conidiomata were found to develop from long, narrow, thin, white primary stromata formed on either or both sides of the midrib on the adaxial leaf surface (Rykard *et al.*, 1984). Palisades of conidiophores were reported to develop in well-defined, irregular, hysteriform "structures" scattered on the stroma surface before the leaf blade expanded. Perithecial stromata were formed on the abaxial surface of the leaf blade opposite the conidial stromata. Diehl (1950), in describing the ephemeral anamorph of *B. henningsiana*, made no mention of occurrence on the upper leaf surface but noted that the stromata were found on the abaxial surfaces of unrolling leaves. He referred to the stroma as a "hypothallus". The conidiomata of *B. henningsiana* were described as being linear to hysteriform, with thin, evanescent exciples.

PLATE 1. Leaf segments of *Eragrostis capillaris* showing dark *Ephelis* conidiomata of *Balansia epichloe* on white, adaxially-borne primary stromata [X 5 to X 20]. A, young, more or less discrete, buff-colored fertile areas (indicated by arrowheads); B, older, coalescent conidiomata assuming a linear morphology; C-F, fully developed conidiomata; C, virtually covering entire stroma; D&E, oblong to hysteriform, separated by sterile stromal mycelium, with developing conidiomata (indicated by arrowheads) in close proximity; F, variously confluent, giving an irregular to long-linear aspect.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Conidiomata of *B. epichloe* occurring on *Chasmanthium laxum* (L.) Yates, were reported by Rykard *et al.*, (1984) to be in the form of irregular, hysteriform, coalescing locules bordered laterally by ridges of sterile tissue. When viewed in cross-section the fertile areas were described as having the appearance of saucer-shaped depressions in the stroma. Diehl (1950) noted that conidiomata of *B. epichloe* cover the so-called hypothallus as a whitish film that splits irregularly in elongate, subhysteriform, coalescing pycnidia. These were described as being partly separated by "the dissepiments of the surface layer as peridia".

As already noted (Phelps *et al.*, 1993b), Diehl (1950) made differences in conidiomatal and ascostromatal morphology the basis for recognition of two subgenera of *Balansia*, namely *Eubalansia* and *Dothichloe*. The first was characterized by possession of patellate or cupulate conidiomata with a well-defined margin or excipulum, the second by effuse or hysteriform, more irregular and less clearly defined, fertile areas. The utility of, and need for, these subgeneric taxa have recently been questioned (Morgan-Jones *et al.*, 1992). *Balansia* is not a very large genus and its subdivision on this basis seems of doubtful value.

The anamorph genus *Ephelis* Fr., based on *E. mexicana* Fr., contains very few species although *Ephelis* states are known to be produced by most *Balansia* species currently recognized, including *B. aristidae*, *B. strangulans* and the others mentioned above. The affinity of the type species itself is uncertain (Diehl, 1950; Phelps *et al.*, 1993b). It could be the anamorph of either *Balansia obtecta* Diehl or *B. claviceps* Speg., probably the former. The binomial *Ephelis mexicana* must be considered a *nomen dubium* because it cannot be properly typified. *Ephelis borealis* Ell. & Everh. is the anamorph of *Atkinsonella hypoxylon* (Peck.) Atk. and *E. trinitensis* Cke & Massee the anamorph of *B. claviceps*. The status of *Ephelis japonica* P. Henn. and *E. oryzae* Syd. is also uncertain since there seems little difference between the two (Phelps *et al.*, 1993b) and a teleomorph connection is not known for either.

Our collection and recent studies of several members of the Balansieae in the southeastern United States (Morgan-Jones and White, 1992; Morgan-Jones *et al.*, 1993; Phelps *et al.*, 1993a, 1993b, 1993c) have been aimed at better understanding host-pathogen relationships and documenting in greater detail the characteristics of the respective fungi. The relationship between *B. epichloe* and *Eragrostis capillaris* (L.) Nees and *E. elliottii* was reported upon in part VII of this series (Phelps *et al.*, 1993c). In the present paper, the development and morphology of the *Ephelis* anamorph of *B. epichloe* on leaves of *E. capillaris* are described.

MATERIALS AND METHODS

Test plants used during these studies were collected and maintained as described by Phelps *et al.* (1993c). Leaf segments bearing ephelidial stromata at various stages of development were harvested and prepared for sectioning. Fixation, dehydration, infiltration, sectioning, and staining procedures were performed as described by Phelps *et al.* (1993a).

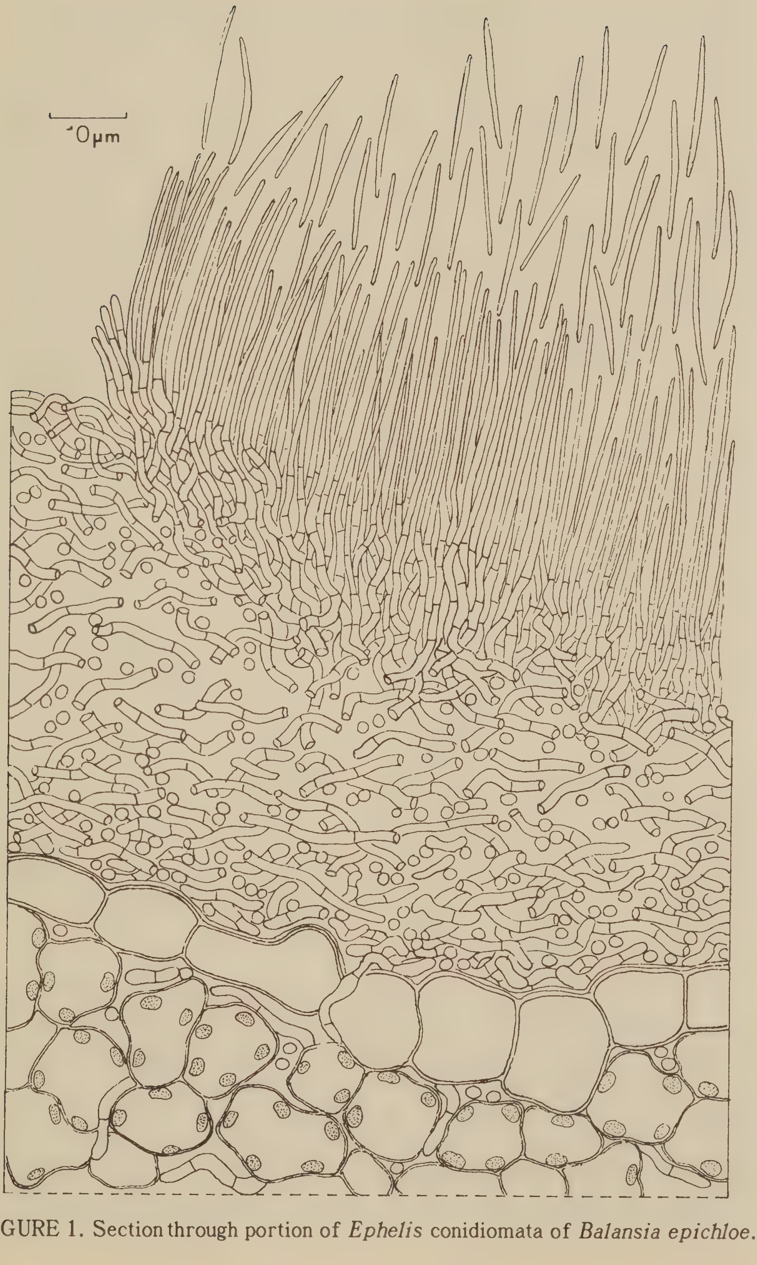


FIGURE 1. Section through portion of *Ephelis* conidiomata of *Balansia epichloe*.

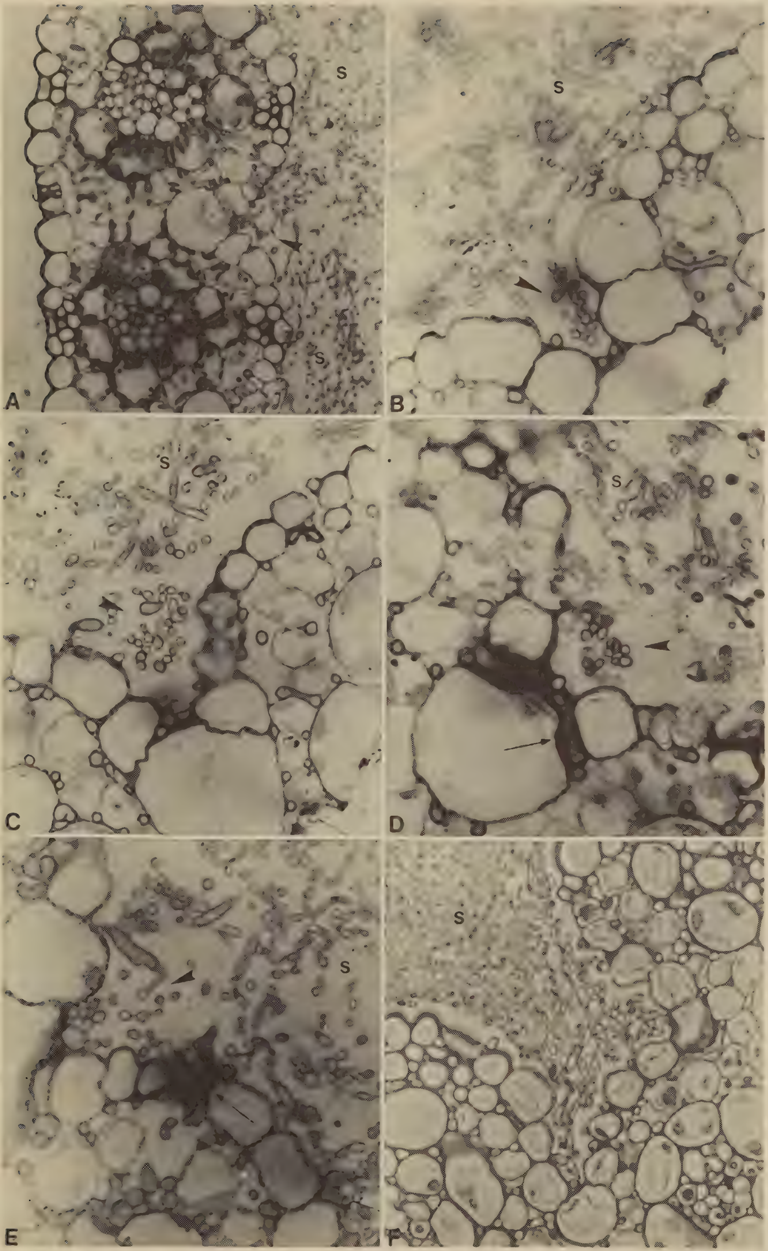
RESULTS

Primary Stroma Development

As documented in a preceding paper of this series (Phelps *et al.*, 1993c), endophytic hyphae of *Balansia epichloe* grow systemically in host leaves, longitudinally for the most part, between cells of both vascular and ground tissue. Prior to stroma initiation, mycelium is relatively scattered and sparse. It is most commonly associated with vascular bundles, particularly those of the midvein. Primary stroma development and *Ephelis* anamorph production may occur on mature, fully expanded leaves or when young and concealed by enveloping leaves. Localized build-up of endophytic hyphae at a particular position along the leaf blade, usually toward the middle, lengthwise, immediately precedes initial hyphal egress. Stroma development follows at the same site. As the area of hyphal concentration spreads in both directions, concurrent egress from the adaxial leaf surface and stroma initiation occurs, both at first along longitudinal grooves (Plate 2, B-D). Hyphal build-up, egress, and stroma formation begin sequentially at the same locus, and subsequently spread up and down the leaf blade. Initially, most hyphae egress between cells of the longitudinal grooves. Small, parallel bundles of hyphae then grow linearly within these intercostal grooves (Plate 2, B-D), eventually filling and overflowing them (Plate 2, F). The stroma appears striate in its youngest stages due to concentration of the delicate hyphal network within longitudinal grooves (Phelps *et al.*, 1993c). In its final dimensions, the primary stroma may cover the width of the blade and extend appreciably in length (Plate 1, C). Eventually the dense, white, cottony stroma thickens, covering the entire width of the affected leaf surface area (Plate 1, A & D). When mature, the primary stromata assume a cream to very pale buff coloration and become more or less prosenchymatous in texture. Constituent hyphae tend to be more densely packed in the vicinity of longitudinal grooves.

Conidiomata develop at or near the surface of the stroma as elliptic to hysteriform to linear pustules (Plate 1, A-F). Conidiophores originate from hyphae occurring a short distance below the stromal surface. At first, the developing palisades of conidiophores are covered by thin wefts of hyphae which are soon disrupted, exposing the fertile areas. Conidiophore palisade primordia are initially scattered (Plate 1, A) but often become progressively longer and coalesce to form long, linear entities (Plate 1, B) following the subtending longitudinal leaf grooves where the stroma is thickest and there is a

PLATE 2. Portions of thin sections showing developing primary stromata of *Balansia epichloe* on adaxial leaf surfaces of *Eragrostis capillaris* plants. A, cross section showing young, loose stroma (s) developing above two leaf veins and in the longitudinal groove (indicated by arrowhead) between them [X 400]; B-E, cross sections showing young, loose stromata (s) and hyphae concentrated within longitudinal grooves (indicated by arrowheads); (hyphae egressing between epidermal cells indicated by arrows in D & E) [X 1000]; F, cross section showing part of a more mature primary stroma (s) filling a longitudinal groove [X 400].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preponderance of underlying, egressing hyphae. The palisades of conidiophores rest on a loose mat of hyphae (Plate 3, D-F) and are essentially acervuloid in aspect although the fructification is entirely superficial. When mature, the conidiomata have a concave, saucer-like form when viewed in cross section. Very young conidiomata are barely distinguishable from the surrounding sterile stromal areas but with the initiation of conidiogenesis become discernible as pale beige to very pale chocolate-colored patches (Plate 1, A). As conidiation progresses, and mounds of conidia accumulate, the conidiomata assume a dark, grayish-brown coloration. Conidiomatal coalescence and profuse conidium production sometimes result in most of the primary stroma becoming covered by dark masses of conidia (Plate 1, C). Under favorable conditions the fertile areas become distinctly pustular in appearance due to the superficial accumulation of conidial masses (Plate 1, D-F).

Taxonomic Description

Ephelis anamorph of *Balansia epichloe* (Weese) Diehl, *USDA Agric. Monogr.* 4:40, 1950.

Mycelium immersed in host leaf tissue, composed of hyaline, septate, smooth, branched, 1.5-2 µm wide hyphae, distributed predominantly in the vicinity of vascular bundles and immediately surrounding mesophyll. Hyphae egressing predominantly between epidermal cells (Plate 2, D & E) or through stomata. Primary stroma effuse to diffuse, especially toward the margin, superficial, thin, at first somewhat lanose (Plate 1, E), becoming felted, loosely prosenchymatous when mature, denser where close to the leaf surface, particularly in proximity to longitudinal grooves, up to 120 µm thick, up to 2.5 cm in length, 2-6 mm wide, white when young, cream to very pale buff when mature. Conidiomata eustromatic, as localized, undifferentiated, fertile areas originating closely beneath the stroma surface, ephemeral, erumpent from below a narrow layer of loosely interwoven hyphae, initially scattered, becoming gregarious or sometimes confluent, elliptic to oblong to hysteriform or long-linear in outline (Plate 3, D & F), acervular, saucer-shaped (Plate 3, D), bordered peripherally by a small cluster of closely appressed, vertically oriented, sterile hyphal cells as a rudimentary exciple (Figure 1), separated and bordered by sterile strips of the primary stromata, about 1 mm wide, of various lengths up to 1 cm. Conidiophores (Figure 2) micronematous, hyaline, smooth, septate, simple or branched, arranged in dense fascicles, formed from hyphae lining the base of the conidiomata. Conidiogenous cells long-cylindrical, discrete, terminal or lateral, attenuating slightly toward the distal end, straight or slightly flexuous, holoblastic, proliferating sympodially, indeterminate, giving rise to a sequence of a few conidia at the apex, 1-1.5 µm wide. Conidia hyaline, aseptate, narrowly fusiform, guttulate, more or less straight or slightly curved, thin-walled, smooth, obtuse at the apex, subtruncate at the base, (16)-18-(21) X 1 µm (Figure 2).

On a number of Poaceae genera, including *Andropogon* L., *Calamagrostis* Adams., *Chloris* Sw., *Ctenium* Panz., *Eragrostis* Wolf, *Gymnopogon* P. Beauv., *Panicum* L., and *Sporobolus* R. Br.; North, Central, and South America.

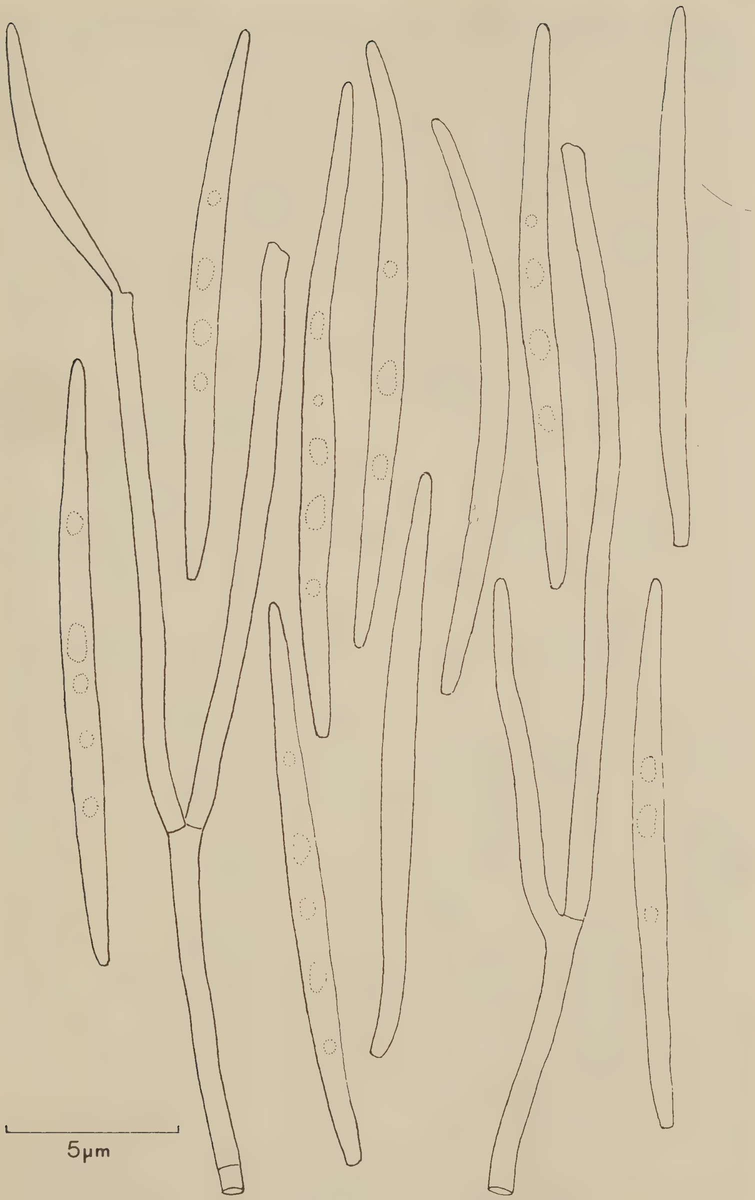


FIGURE 2. *Ephelis* state of *Balansia epichloe*. Conidiophores and conidia.

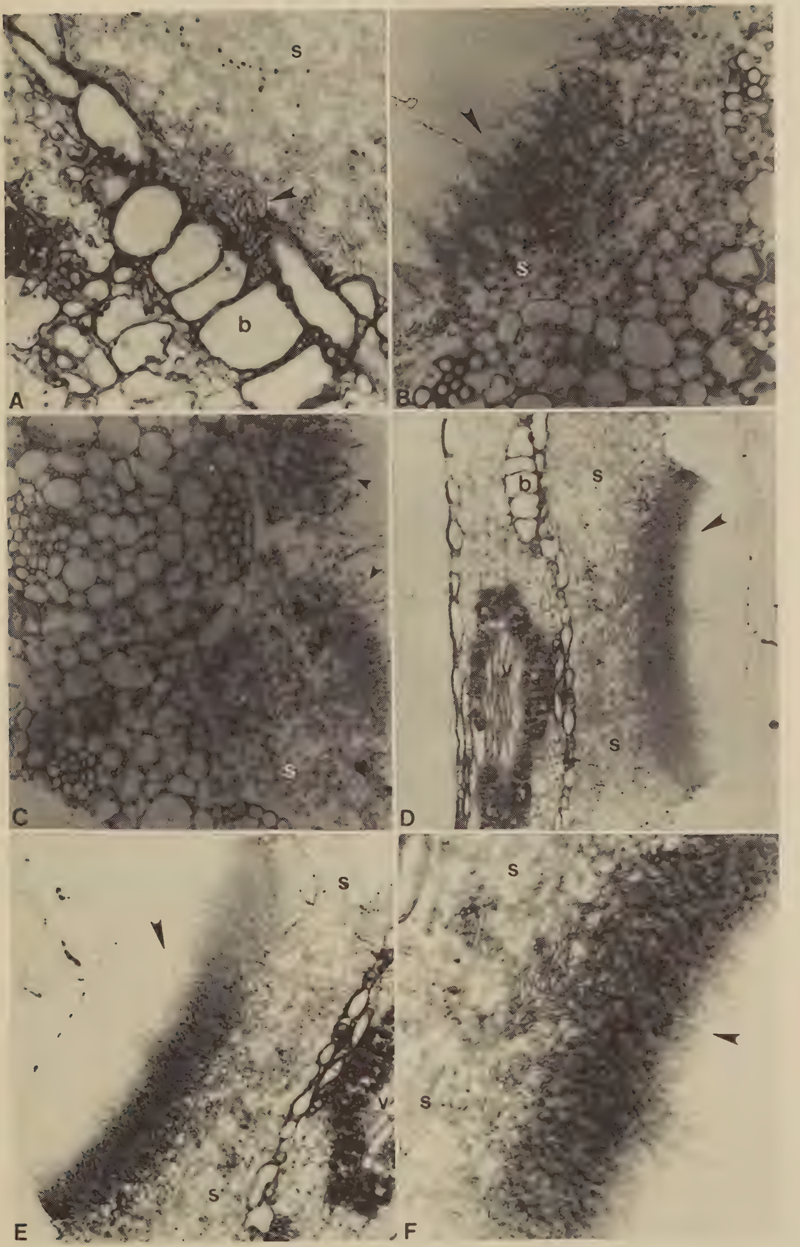
Collections examined: on *Eragrostis capillaris*, Auburn, Lee County, Alabama, August 1991, G. Morgan-Jones, AUA; on *E. elliottii*, Geneva County, Alabama, July 1991, R.A Phelps, AUA.

DISCUSSION

Although *Balansia epichloe* and *B. henningsiana* overlap in host range, both occurring on *Andropogon scoparius* Michx., *Gymnopogon ambiguus* (Michx.) B.S.P. and *Panicum agrostoides* Spreng. in the United States (Diehl, 1950), and are of broadly similar morphology, they are considered distinct species. Not surprisingly, their superficial resemblance has led in the past to their being regarded as a single entity. In a key to species of *Balansia*, Diehl (1950) separated the two taxa on the basis of their fructifications being produced on opposite leaf surfaces; on the adaxial side in the case of *B. epichloe*, on the abaxial side in *B. henningsiana*. Hyphal egress can, however, apparently occur in both species from either leaf surface. Phelps *et al.* (1993c) reported outward passage of hyphae of *B. epichloe* between epidermal cells on the abaxial leaf in *Eragrostis capillaris*. Such hyphae do not continue to grow and give rise to primary stromata however. As already mentioned, Rykard *et al.* (1984) found the anamorph state of *B. henningsiana* formed on the adaxial surface of leaves of *Andropogon virginicus*. Ascostromata of the two species invariably occur on the different surfaces, in *B. epichloe* by conversion of the primary stroma and development of perithecial initials a short distance below the conidiophore palisade. From the account by Diehl (1950), and bearing in mind the observations made by Rykard *et al.* (1984), it seems that *B. henningsiana* can form primary stromata bearing conidiomata on either leaf surface but further investigation of this species on different hosts is required for purposes of confirmation.

The conidiomata of *B. epichloe* differ from those of species of *Balansia* having effuse stromata occurring on culms, such as *B. aristidae* (Atk.) Diehl (Phelps *et al.*, 1993b), in being much less well-defined and differentiated. The primary stroma of *B. aristidae* becomes melanized at or about the time of conidiomatal initiation and assumes a pseudoparenchymatous texture. Conidiomata originate as locules in the stroma, the palisade of conidiophores becoming exposed by a longitudinal split in the overlying tissue.

PLATE 3. Portions of thin sections showing developing primary stromata of *Balansia epichloe* on adaxial leaf surfaces of *Eragrostis capillaris* plants. A, oblique section showing bulliform cells (b), hyphae packed in longitudinal groove (indicated by arrowhead), and overlying stroma (s) [X 500]; B & C, cross sections showing *Ephelis* palisades (indicated by arrows) beginning to form on underlying primary stromata (s) [X 300]; D-F, different magnifications of a slightly oblique section showing a primary stroma (s) bearing a fully developed *Ephelis* conidioma (indicated by arrowheads) [D; X 150; E; X 200; F; X 400]. Underlying plant tissue includes bulliform cells (b) associated with a longitudinal groove, and vascular tissue (v) surrounded by dark bundle sheath cells.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A new species of *Ascotricha* with non-ostiolate ascomata

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Abstract

Ascotricha distans, a new species with a *Dicyma* anamorph, is described and illustrated from soil in Japan. It is unique because of the production of non-ostiolate ascomata, few ascomatal hairs and evanescent asci, adaptive characters for its terrestrial habitat. The *Dicyma* anamorph is characterized by short conidiophores without sterile ampulliform processes, geniculate, rachis-like conidiogenous cells and pale, subglobose, almost smooth conidia.

Key Words *Ascotricha* , *Dicyma*, cleistothecial ascomycete,
Xylariaceae, taxonomy, soil fungus

The genus *Ascotricha* Berk. now contains 9 accepted species, all of which have anamorphs classified in the form-genus *Dicyma* Boulanger (Hawksworth, 1971; Kulshreshtha et al., 1977; von Arx, 1981). Most species of *Ascotricha* are probably cosmopolitan in distribution, and are commonly isolated from cellulosic substrates (e.g. paper, wood, fabrics, plant debris, seeds, dung, etc.), particularly in tropical to subtropical regions (Hawksworth, 1971; Hanlin, 1990). The occurrence in soil suggests an active role in decomposing processes of cellulosic materials such as litter.

During our exploratory survey of soil-borne ascomycetes as producers of secondary metabolites useful to the pharmaceutical industry, an interesting member of *Ascotricha* was isolated from cultivated soil in a herbal plant garden, southern Kyusyu. The fungus superficially resembles *A. amphitricha* (Corda) Hughes (Hawksworth, 1971) in morphology of ascomatal hairs, but differs from it in producing non-ostiolate ascomata with few hairs and clavate asci, as well as in its conidial characters. Recently, Valldosera and Guarro (1988) erected the monotypic genus *Ascotrichella*, which was considered as a transitional form of the Xylariaceae between *Ascotricha* and *Coniochaeta* (Sacc.) Cooke. *Ascotrichella hawksworthii* Valldosera et Guarro is characterized by short hairy ostiolate ascomata, cylindrical asci with a non-amyloid apical apparatus, discoid ascospores with a longitudinal germ slit and a *Humicola*-like anamorph. Our fungus distinctly differs from *Ascotrichella hawksworthii* in having long, distinct, smooth-walled hairs and a *Dicyma* anamorph. Thus, it is described as a new species of *Ascotricha* herein.

Ascotricha distans Udagawa, Uchiyama et Kamiya, sp.nov. Figs. 1, 2

Coloniae in agaro cellulosa restrictae, planae, tenues, ex mycelio vegetativo submerso et hyphis aeriis sparsis formantes, brunneo-griseae vel ferro-griseae; ascomata tarde producentia, nigra; conidiogenesis dispersa; reversum fumosum.

Ascomata superficialia vel immersa, dispersa, non-ostiolata, nigra, nitida, globosa vel subglobosa, 70-120 μm diam, paucipilosa; pili dimorphi: (a) longi, flagelliformes, atrobrunnei, rigidi, simplices, 500-1000 × 2-2.5 μm, basi 5-7.5 μm diam, angustati, leves, septati, raro cum ramis ampulliformibus instructi, (b) setiformes, saepe deminuentes, aseptati vel pauciseptati, abrupte angustati, ad apicem interdum cellula ampulliformi hyalina formantes; peridium olivaceo-brunneum, tenue, ex "textura epidermoidea" compositum. Asci 8-spori, clavati, 30-42.5 × 7.5-10 μm, brevi-stipitati, evanescentes; paraphyses nullae. Ascosporae biseriatae, primum hyalinae, postremo valde olivceo-brunneae, ovoideae vel ellipsoideae, compressae a latere visis, 5-6.5 (-7.5) × 4.5-5 × 3-3.5 μm, leves, fissura germinali paratae. Status anamorphus: *Dicyma* sp.

Holotypus BF 39285, colonia exsiccata in cultura ex solo sativo, Kaimon-cho, Ibusuki-gun, Kagoshima, in Japonia, 28. ix. 1992, a S. Uchiyama et S. Kamiya isolata et ea collectione fungorum, Musei et Instituti Historiae Naturalis Chiba (CBM) conservata.

Etymology: from Latin, *distans*=distinct, referring to the distinct characters of ascomata.

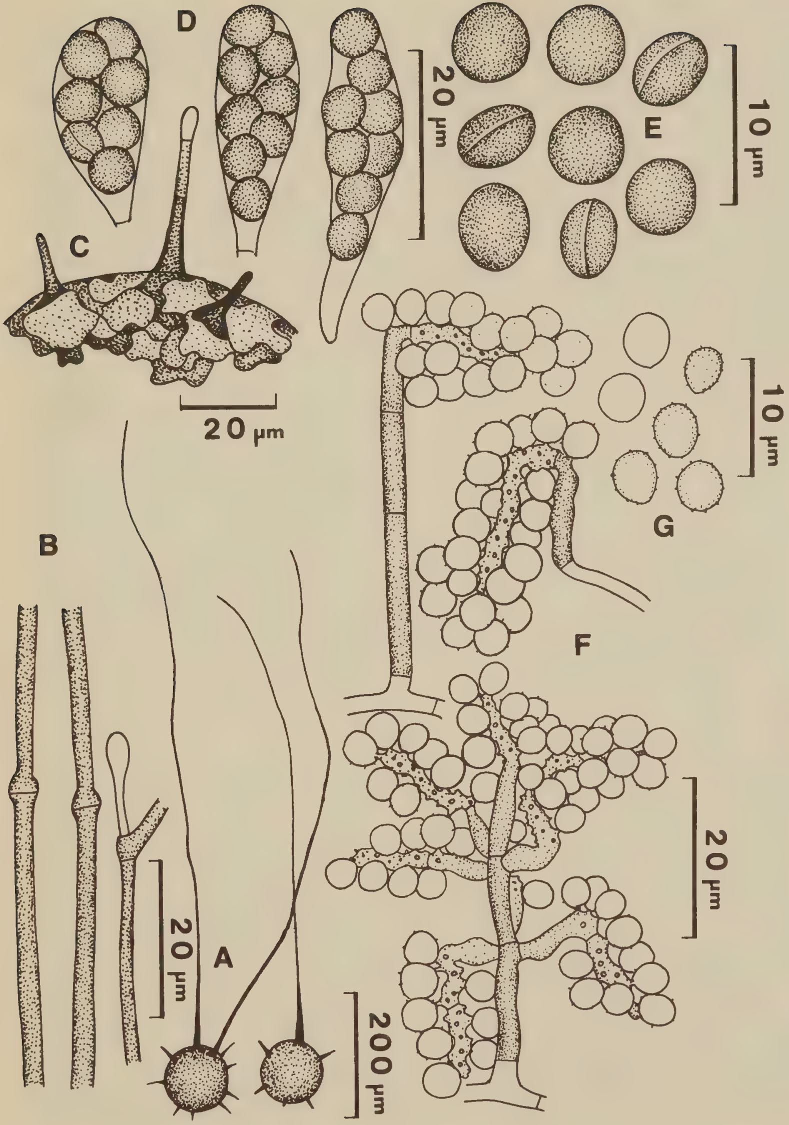
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Fig. 1. *Ascotricha distans*, BF 39285.
A. Ascomata; B. Portions of long ascomatal hairs; C. Seta-like short ascomatal hairs; D. Asci; E. Ascospores; F. Conidiogenous cells; G. Conidia.

Anamorphosis: *Dicyma* sp.

Mycelium ex hyphis hyalinis vel dilute brunneis, ramosis, septatis, levibus, 1-2.5 µm diam compositum. Conidiophora erecta, ex mycelio basali vel hyphis aeriis oriunda; stipites 10-50 × 1.5-3 µm, leves, incrassati, septati, simplices vel apicaliter verticillate ramosi, basi olivaceo-brunnei, apicem versus gradatim pallescentes et angustati. Cellulae conidiogenae ex conidiophoro simplici vel ramis terminales, subhyalinae vel dilute brunneae, basi ampulliformes vel elongatae, 8-12 × 3-4 µm, apice sympodice prolongatae, usque 20-50 µm longae, 2.5 -3 µm diam, geniculatae. Conidia ex denticulis terminalibus successivis singulatim producta, hyalina vel dilute olivaceo-brunnea, subglobosa, 3.5-5 µm diam, vel obovoidea, 3-5.5 × 2.5–5 µm, levia vel parum asperata, ad basim cicatrice inconspicua affixa.

Holotypus BF 39285, loc. cit.

Colonies on cellulose agar growing restrictedly, attaining a diam of 10-12 mm in 14 days at 25°C, plane, thin, consisting of a submerged vegetative mycelium and sparse aerial hyphae, Brownish Grey (M. 6F2, after Kornerup and Wanscher, 1978) or Iron Grey (Rayner, 1970), later producing black ascomata on the substratum; conidiogenesis sparse; reverse Smoke Grey (R). Colonies on potato-carrot agar (PCA) growing rather restrictedly, attaining a diam of 17-19 mm in 14 days at 25°C, velvety, plane or slightly sulcate, consisting of a thin basal felt, Dark Green (M. 27F3) or Olivaceous Black (R), producing abundant ascomata covered by a dense overgrowth of conidia; reverse Greenish Grey (M. 27F2) or Olivaceous Black (R).

Ascomata superficial or sometimes immersed, often intermixed with profuse conidiophores, scattered, non-ostiolate, black, shining, globose to subglobose, 70-120 µm diam, with a few, long, straight or slightly flexed hairs on the upper part and several short ones the lower part; ascomatal hairs of two types: (a) long, whip-like, dark brown, rigid, unbranched, 500-1000 µm long, basally 5-7.5 µm wide, tapering and 2-2.5 µm wide throughout most of the length, smooth and thick-walled, septate, slightly swollen at the septum, rarely with short hyaline ampulliform branches, and (b) seta-like, often diminished, aseptate or few septate, abruptly tapering to a pointed tip or a hyaline ampulliform cell measuring 7.5-15 × 3-5 µm; ascomatal peridium olivaceous brown, thin, of textura epidermoidea; outer layer consisting of dark, thick-walled, irregular cells measuring 5-7.5(-12.5) µm diam, and inner layer of hyaline, thin-walled, angular cells. Asci 8-spored, clavate, 30-42.5 × 7.5-10 µm (p. sp. 17.5-25 µm long), short-stipitate up to 7.5-12.5 µm long, thin-walled, without apical structures, evanescent; paraphyses not observed. Ascospores biseriate, at first

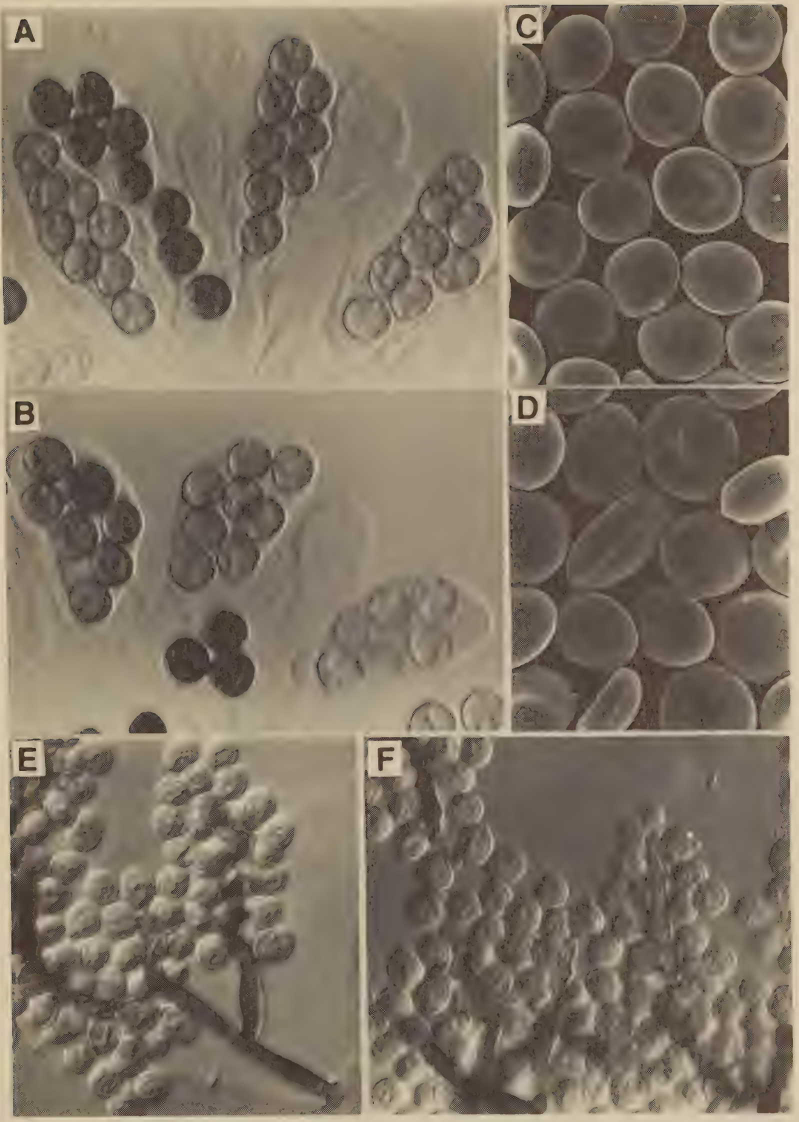

Fig. 2. *Ascotricha distans*, BF 39285.

A, B. Asci, × 1200; C, D. Ascospores (SEM), × 2245(C) and × 2500(D); E, F. Conidiogenous cells and conidia, × 1200.

hyaline, becoming dark olivaceous brown at maturity, ovoid to ellipsoidal, compressed when seen edgewise, 5-6.5(-7.5) × 4.5-5 × 3-3.5 µm, rounded at both ends, smooth-walled, with a longitudinal germ slit.

Mycelium consisting of hyaline to pale brown, branched, septate, smooth-walled, 1-2.5 µm thick hyphae. Conidiophores erect, arising from the basal mycelium or aerial hyphae; stipes short, 10-50 × 1.5-3 µm, smooth and thick-walled, septate, unbranched or apically branched a few times in verticillate arrangements, olivaceous brown at the base, gradually paling and tapering towards the apex. Conidiogenous cells arising terminally from unbranched conidiophore or branches of the conidiophore, subhyaline to pale olivaceous brown, consisting of a flask-shaped to elongate basal part, 8-12 × 3-4 µm, and a well-developed, denticulate rachis to 20-50 µm long and 2.5-3 µm wide, geniculate, with crowded, distinct, about 1 µm wide conidium-bearing denticles. Conidia acropleurogenous, produced sympodially on the denticle, hyaline to pale olivaceous brown, subglobose, 3.5-5 µm diam, or obovoid, 3-5.5 × 2.5-5 µm, the walls smooth to faintly roughened, with an inconspicuous basal scar.

At 37°C, growth is nil.

Specimen examined: BF 39285 (holotype), in dried culture isolated from cultivated soil, herbal plant garden, Kaimon-cho, Ibusuki-gun, Kagoshima-pref., Japan, 28 Sept. 1992, col. S. Uchiyama and S. Kamiya. The holotype has been deposited with the Natural History Museum and Institute, Chiba, Japan (CBM).

The genus *Ascotricha* is found in the earlier literature under the Chaetomiaceae (Ames, 1963). On the basis of the distinct neck on the perithecia, the smooth-walled terminal hairs, the amyloid plug in the asci, the prominent germ slit in the ascospores and the anamorphs close to *Geniculosporium-Nodulisporium*, it is distinguished from *Chaetomium* and now best included in the Xylariaceae (Hawksworth and Wells, 1973; Khan and Cain, 1977; von Arx, 1982; Eriksson and Hawksworth, 1991). *Ascotricha distans* is the first species of the genus known to produce cleistothecia, with few hairs and evanescent asci. As in the Ceratostomataceae, Chaetomiaceae Lasiosphaeriaceae, Microascaceae and Sordariaceae, particularly in species found in soil, such morphological adaptations are well-recognized by the result of a progressive evolution away from dispersal of ascospores by means of air currents. Although there are only a few examples in the Xylariaceae (Malloch and Rogerson, 1977), the convergence in the ascoma characters of *A. distans* is considered to be an adaptation to its terrestrial habitat analogous to those in other cleistothecial ascomycetes.

The *Dicyma* anamorph of new species, is not entirely typical of *Dicyma* states of *Ascotricha* species as described by Hawksworth (1971) and von Arx (1982) on account of the absence of sterile ampulliform cells on the conidiophores. Of the known species of *Dicyma* (von Arx, 1982; Guarro and Calvo, 1983), *D. pulvinata* (Berk. et Curt.) von Arx (=*Hansfordia pulvinata* (Berk. et Curt.) Hughes) is most close to our fungus. *Dicyma pulvinata* differs from the fungus in having long, slender conidiophores with a well-developed branching system, conidiogenous cells with a very short rachis and somewhat larger conidia (Hughes, 1951; Tubaki, 1958; Ellis, 1971; Matsushima, 1975; von Arx, 1981).

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MYCOTAXON

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TALAROMYCES SPECTABILIS, A NEW SPECIES OF FOOD-BORNE ASCOMYCETES

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ABSTRACT

A new species of *Talaromyces* with a *Paecilomyces* anamorph, *T. spectabilis* Udagawa et S. Suzuki, isolated from heat processed fruit beverage in Japan as a contaminant and from road-side soil in Nepal, is described and illustrated. The fungus is characterized by fast growing, olivaceous brown colonies, white ascomata, large, almost smooth-walled, ellipsoidal ascospores, repeatedly branched conidiophores and cylindrical to ovoidal conidia.

A variety of heat resistant fungi are often found in spoilage of fruit juices and other heat processed beverages. The contamination of these products is generally caused by members of soil-borne ascomycetes such as *Byssochlamys*, *Eupenicillium*, *Hamigera*, *Neosartorya* and *Talaromyces* (Samson, 1989; Samson et al., 1992).

During a survey of mold spoilage of commercial beverages in our laboratory, a number of heat resistant fungi were isolated. Among these is a cleistothecial ascomycete belonging to *Talaromyces* C. R. Benjamin (Stolk and Samson, 1972). Based on the presence of a *Paecilomyces* anamorph and its thermotolerant growth, it is classified in the section *Emersonii* (Stolk and Samson, 1972) of the genus but is clearly distinct from the two related species described hitherto. A description of the fungus is provided herein and a new name is proposed for it.

Talaromyces spectabilis Udagawa et S. Suzuki, sp.nov.
Figs. 1, 2

Coloniae in agaro "Czapek-yeast extract (CYA)" effusae, velutinae vel funiculosae, planae sed in centro rugosae et sulcatae, ex mycelio basali coacto tenuiter constantes, olivaceo-brunneae vel viridi-olivaceae; ascomata nulla vel limitata; conidiogenesis profusa; reversum griseo-flavum vel olivaceo-bubalinum. Coloniae in agaro maltoso (MEA) effusae, velutinae vel funiculosae, planae, ex mycelio basali coacto tenuiter constantes, olivaceo-brunneae vel melleae vel viridi-olivaceae; ascomata tarde producentia sed abundantia, alba; conidiogenesis conferta; reversum incoloratum vel brunneo-aurantiacum vel melleum. Coloniae in agaro farinae avenaceae effusae, velutinae vel plus minusve funiculosae, planae, ex mycelio basali coacto tenuiter constantes, olivaceo-brunneae vel viridi-olivaceae; ascomata tarde producentia, alba; conidiogenesis profusa; reversum dilute flavum vel primulinum.

Ascomata discreta vel interdum confluentia, non-ostiolata, tarde maturescentia, alba, globosa vel subglobosa, 100-350(-480) µm diam, mollia, mycelio laxo stricto vel sinuoso stramineo incrustato obtecta; paries ex hyphis hyalinis vel dilute flavis ramosis septatis varie asperatis intricatis compositus. Asci singulariter formantes, (4-)8-spori, subglobosi vel late ovoidei vel pyriformes, 10-14 x 10-12 µm, brevistipitati, evanescentes. Ascosporae postremo stramineae, ellipsoideae, 5.5-7(-9) x 4-5.5 µm, fere leves et incrassatae. Status anamorphus: *Paecilomyces spectabilis*.

Ubiquinona principalia: Q-9 et Q-10.

Holotypus SUM 3030, colonia exiccata in cultura ex potione pomo, Tokyo, in Japonia, xi.1992, a S. Suzuki isolata et ea collectione fungorum, Musei et Instituti Historiae Naturalis Chiba (CBM) conservata.

Etymology: from Latin, *spectabilis*=remarkable, referring to the wide-spread growth on common media.

Anamorphosis: *Paecilomyces spectabilis* Udagawa et S. Suzuki, anam.nov.

Conidiophora ex mycelio basali vel hyphis aeriis oriunda; stipites hyalini, 25-240 x 4-6(-8) µm, leves sed inferne manifesto asperati, septati. Penicilli complexi, verticillati vel irregulatim ramosi, saepe divergentes, interdum biverticillati vel monoverticillati. Rami 7-35 x 2.5-5(-7) µm. Metulae 2-4 verticillatae, 8-10 x 2.5-3(-6) µm. Phialides 2-8 verticillatae, 10-30 x 1.5-4 µm. Conidia hyalina vel dilute flavo-brunnea, levia, pri-

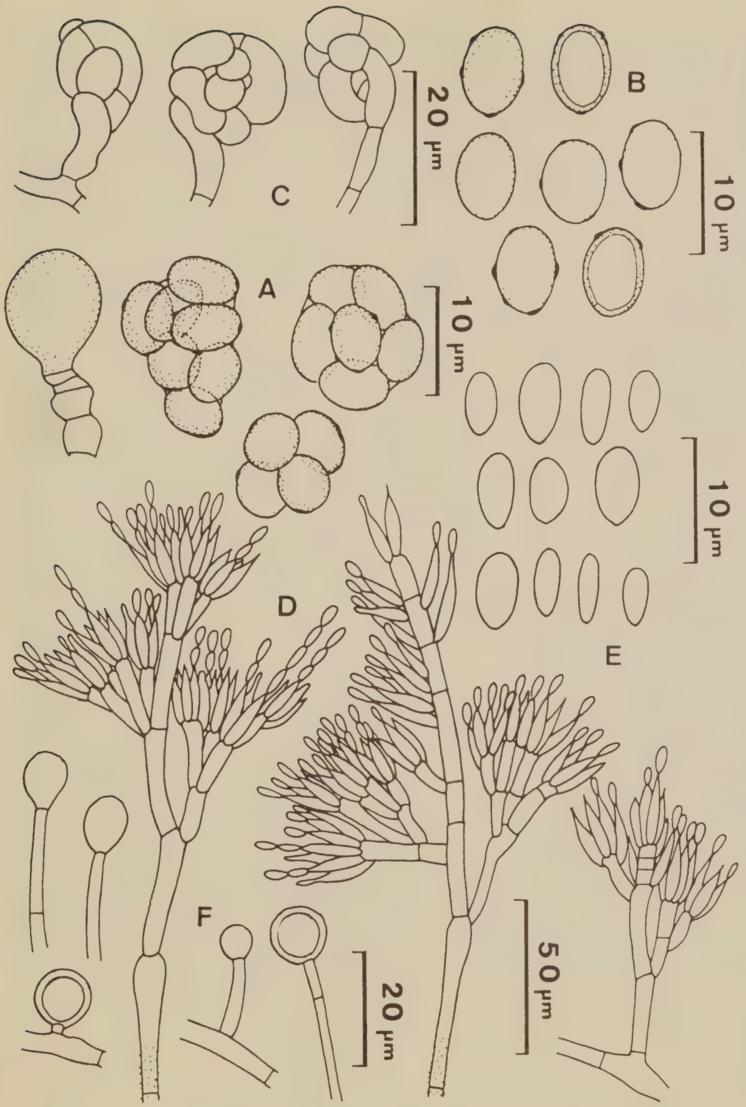
B
C
20 µm
10 µm
A
10 µm
10 µm
D
E
F
20 µm
50 µm

Figure 1. *Talaromyces spectabilis*, SUM 3030.
A. Asci. B. Ascospores. C. Ascomatal initials.
D. Conidiophores and conidiogenous cells. E. Conidia.
F. Chlamydospores.

mum cylindracea, 4-7 x 1.5-2(-3) µm, utrinque saepe truncata, postremo ovoidea vel ellipsoidea, 4-10 x 2-7 µm, in catenis laxe columnaribus vel implicatis connexa. Status teleomorphus: *Talaromyces spectabilis*.

Holotypus SUM 3030, loc. cit.

Colonies on Czapek agar growing rapidly, attaining a diameter of 38-52 mm within 7 days at 25°C, velvety to more or less funiculose, plane, consisting of a thin basal felt, Olive Brown (M. 4D6, after Kornerup and Wanscher, 1978) or Honey to Citrine (Rayner, 1970); ascomata usually absent; conidiogenesis profuse; odor musty; reverse Greyish Yellow (M. 4C3) or Olivaceous Buff (R). Colonies on CYA growing rapidly, attaining a diameter of 65-75 mm within 7 days at 25°C, velvety to funiculose, plane but centrally wrinkled and sulcate, consisting of a thin basal felt, Olive Brown (M. 4E6) or Greenish Olivaceous (R); margins broad and submerged; ascomata absent or limited; conidiogenesis profuse; exudate limited, clear; odor strongly musty; reverse Greyish Yellow (M. 4C4) or Olivaceous Buff (R). Colonies on MEA spreading broadly, attaining a diameter of 74-85 mm or more within 7 days at 25°C, velvety to funiculose, plane, consisting of a very thin basal felt, Olive Brown (M. 4D5-E4) or Honey to Greenish Olivaceous (R), with surface becoming dense-textured due to conidial growth; margins broad and thin; ascomata slowly developing in an uneven layer beneath the conidial growth, numerous in number, white; odor musty; reverse uncolored to Brownish Orange (M. 5C4) or Honey (R). Colonies on oatmeal agar spreading broadly, attaining a diameter of 68 mm or more within 7 days at 25°C, velvety to more or less funiculose, plane, consisting of a thin basal felt, Olive Brown (M. 4E4) or Greenish Olivaceous (R); ascomata slowly developing on the felt, white; conidiogenesis profuse; reverse Pale Yellow (M. 1A3) or Primrose (R). Colonies on cornmeal agar growing rapidly, attaining a diameter of 60-62 mm within 7 days at 25°C, plane, thin, vegetative mycelium submerged, with surface bearing scattered conidia, Olive Brown (M. 4D5) or Honey (R); ascomata limited; reverse uncolored.

Ascomata discrete or sometimes confluent, non-ostiolate, maturing slowly within 30 days, white, globose to subglobose, 100-350(-480) µm in diam, soft, loosely covered by straight or sinuous, straw-colored, encrusted hyphae; ascomatal wall rather rudimentary, consisting of a loose network of hyaline to light yellow, branched, septate, often constricted at the septum, variously

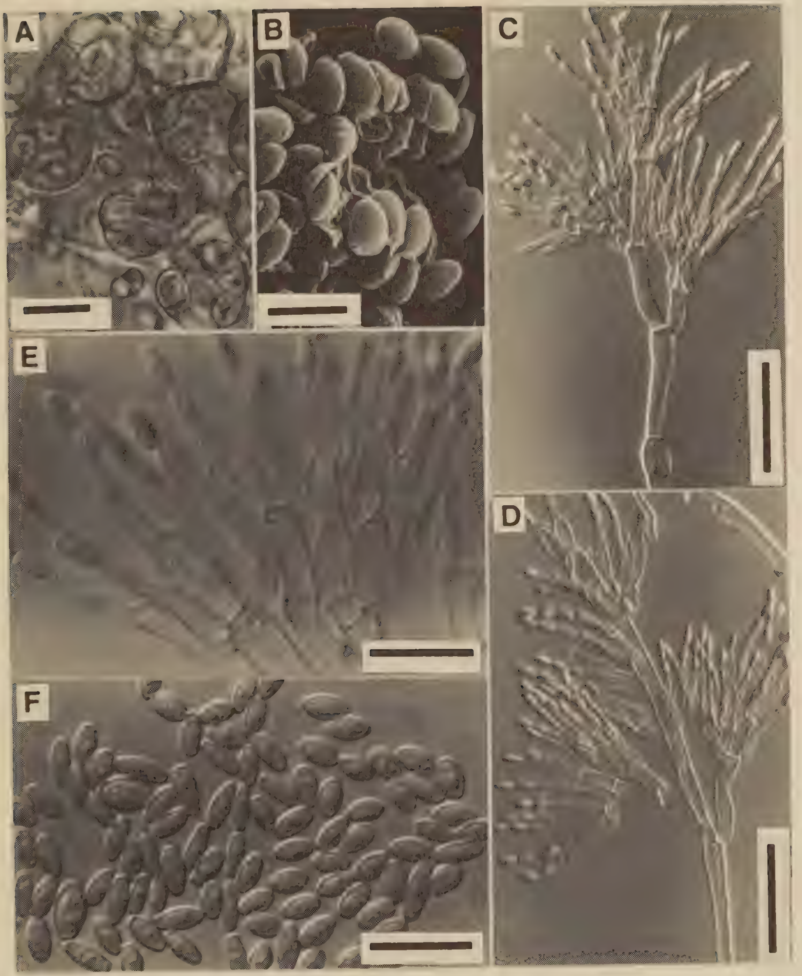

Figure 2. *Talaromyces spectabilis*, SUM 3030. A. Asci. B. Ascospores. C, D. Conidiophores and conidiogenous cells. E. Conidiogenous cells. F. Conidia. Scale bars for A, B, E, F=10 µm and for C, D=20 µm.

roughened, interwoven hyphae measuring 2-4 µm in diam. Ascomatal initials arising as coiled or contorted side branches of aerial hyphae, soon becoming surrounded by hyphae arising from the neighboring cells. Asci borne singly from fertile hyphae, (4-)8-spored, subglobose to broadly ovoidal or pyriform, 10-14 x 10-12 µm, short-stipitate, evanescent. Ascospores straw-colored at maturity, ellipsoidal, 5.5-7(-9) x 4-5.5 µm, more or less roughened when young, almost smooth and thick-walled, without ridges.

Conidiophores arising from the basal mycelium or aerial hyphae; stipes hyaline, 25-240 x 4-6(-8) µm, smooth-walled but distinctly roughened in lower part, septate, sometimes swollen at the septum. Penicilli (conidiogenous cells) complex, consisting of a dense whorl of verticillately or irregularly arranged, often divaricate branches, sometimes biverticillate or monoverticillate. Rami variable and often arranged at different levels, divergent, sometimes recurved, 7-35 x 2.5-5(-7) µm. Metulae not readily distinguishable from the uppermost rami, 2-4 in the verticil, 8-10 x 2.5-3(-6) µm. Phialides 2-8 in the verticil, 10-30 x 1.5-4 µm, consisting of a cylindrical basal portion, tapering abruptly to a long distinct neck, smooth-walled. Conidia hyaline to pale yellow-brown, smooth-walled, variable in shape, cylindrical, 4-7 x 1.5-2(-3) µm, with both ends truncated, becoming ovoidal to ellipsoidal, 4-10 x 2-7 µm, borne in loosely columnar or disordered, long chains up to 200-300 µm long or more. Chlamydospores present, brown, globose or pyriform, 5.5-10 µm in diam, smooth and thick-walled, either terminal or intercalary. Racquet mycelium present, swollen near the septum up to 10-12 µm in diam. Mycelium consisting of hyaline or brown, branched, often thick-walled, smooth or roughened, septate, 1.5-7.5 µm wide hyphae.

Main ubiquinones: Q-9 + Q-10.

At 37°C, growth is slightly faster.

Specimens examined: SUM 3030 (holotype), in dried culture isolated from heat processed fruit beverage as a contaminant, Tokyo, Japan, November 1992, col. S. Suzuki; and SUM 3031, in dried culture isolated from road-side soil, Ring Road, Kathmandu, Nepal, 30 September 1986, col. S. Udagawa. The holotype has been deposited with the Natural History Museum and Institute, Chiba, Japan (CBM).

Talaromyces spectabilis is distinctive in several respects. There is some superficial similarity between

Table 1. Differential characters of the species of *Talaromyces* with a *Paecilomyces* anamorph

	T. spectabilis	*T. byssochlamydoides*	*T. leycettanus*
Growth on CYA (7 d, 25°C)	65–75 mm	None	1–4 mm
Colony color (MEA)	Olive Brown	Pastel Red	Greyish Yellow
Ascomata (µm)	White, 100–480	Reddish, 40–100	Yellowish, 60–250
Ascospores (µm)	Ellipsoidal, nearly smooth, 5.5–9 x 4–5.5	Globose to ovoidal, nearly smooth, 4–5 x 3.5–4.5	Ellipsoidal, with ridges, 3–4 x 2–3
Conidiophores (µm)	Rough in lower parts, 25–240 x 4–8	Smooth, 20–265 x 3–6.5	Smooth, 160–320 x 2–5
Conidia (µm)	Cylindrical, 4–7 x 1.5–3; ovoidal, 4–10 x 2–7	Cylindrical, 4–8 x 1–2.5; ovoidal, 3–7.5 x 2–5	Cylindrical to ellipsoidal, 3–6 x 1.5–3
Ubiquinone	Q-9 + Q-10	Q-10(H_2) or Q-10 + Q-10(H_2)*	Q-10*

* Data from Kuraishi et al. (1991).

two described species of the genus, viz. *T. byssochlamydoides* Stolk et Samson and *T. leycettanus* Evans et Stolk in their thermo-resistant property and in the associated *Paecilomyces* anamorphs (Evans and Stolk, 1971; Stolk and Samson, 1972; Samson, 1974). From both species, *T. spectabilis* differs in having much larger ascospores as well as in other several characters shown in Table 1. The *Paecilomyces* anamorph of *T. spectabilis* can be distinguished from *Paecilomyces variotii* Bainier (Samson, 19 74) in having larger conidium-bearing structures and longer cylindrical conidia. The ubiquinone system of *P. variotii* was determined as only Q-9 or Q-10 by Kuraishi et al. (1985). This also supports a specific separation of *P. variotii* from the anamorph of the new species.

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NOTES ON THE GENUS MONOICOMYCES (LABOULBENIALES, ASCOMYCOTINA): ON THE SPECIES DESCRIBED BY SPEGAZZINI

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ABSTRACT

In order to clear up the taxonomic status of *Monoicomyces ternatus*, *Monoicomyces unilateralis* and *Monoicomyces venetus* their types have been studied. *M. ternatus* and *M. unilateralis* are here proposed as new synonyms for *Monoicomyces homalotae*. *M. venetus* is retained as a separate species.

Spegazzini described six species of *Monoicomyces*: *M. infuscatus* Speg. on *Gyrohypnus bonariensis* Gemm. & Har. (=*G. gracilis*, as *Xantholinus gracilis* Boh.) from Argentina (Spegazzini, 1912); *M. affinis* Speg. on an undetermined staphylinid from Italy; *M. ternatus* Speg. on a mycophilous staphylinid from Italy; *M. unilateralis* on an undetermined staphylinid from Italy; *M. venetus* Speg. on an undetermined staphylinid from Italy (Spegazzini, 1915); and *M. ocaleae* Speg. on *Ocalea funebris* Lynch from Argentina (Spegazzini, 1917).

Monoicomyces affinis was included as synonymous with *Monoicomyces invisibilis* Thaxt. by Thaxter (1931) and this disposition has been subsequently accepted by all the authors who mention *M. invisibilis*. *Monoicomyces ocaleae* is a synonym of *Monoicomyces caloderae* Thaxt. according to Thaxter (1931). I have studied the type of *M. ocaleae*, and my own observations are in full agreement with this opinion. *Monoicomyces infuscatus* is a well defined species strictly parasitic on Xantholinini staphylinids. However, the chief purpose of this note is to comment on the other three species described by Spegazzini: *M. ternatus*, *M. unilateralis* and *M. venetus*.

These three species were described in the same work (Spegazzini, 1915) and no further records have been added. To clear up the taxonomic status of these species I requested the Institute of Botany "C. Spegazzini" in La Plata, Argentina, to lend me their types for examination.

Monoicomyces ternatus Spegazzini, Anales Mus. Nac. Hist. Nat. Buenos Aires 27: 67 (1915)
The slide examined is labelled as follows: "STAFILINO MICOFILO / CONEGLIANO /

XI-1914 / LPS 45061 / SINTIPO".

This slide only contains one mature specimen (fig. 1). According to the description of Spegazzini the most reliable characteristics of this species were the long secondary appendages with clavate cells. As in *M. unilateralis* and *M. venetus*, their descriptions are too brief and the drawings not very clear. My observations suggest that *M. ternatus* is a form of *M. homalotae*, accepted as a variable and rather polymorphic species.

The primary appendage appears to be broken above its second cell. The two basal cells of the primary appendage are deeply brown-pigmented and are separated by a pale septum, as is typical in *M. homalotae*. The antheridial and perithecial features are not distinct from those included in the wide range of characters of *M. homalotae*. Therefore, because of the absence of any outstanding characteristic, I concluded that *M. ternatus* should be a synonym of *M. homalotae*.

Monoicomyces unilateralis Spegazzini, Anales Mus. Nac. Hist. Nat. Buenos Aires 27: 68 (1915)
The slide examined is labelled as follows: "*ATHETA* ? ... MICÓFILA / CONEGLIANO / IX-1914 / LPS 45087 / TIPO".

This slide contains 13 immature or nearly mature specimens (figs. 2-4). Like *M. ternatus*, this species was considered to be related to *Monoicomyces britannicus* Thaxt. by Spegazzini. The most important characteristics were those of the primary appendage and the absence of secondary appendages on the antheridium. Undoubtedly, the specimens seen belong in *M. homalotae*, a species often confused with *M. britannicus* (Santamaria, 1989). Specimens of *M. unilateralis* have characteristics that are very typical in *M. homalotae*: there is a heart-shaped cell I and the base of the primary appendage is deeply brown-pigmented with a characteristic pale ring between the two basal cells. The secondary appendages may be present or be inconspicuous (unicellular) in *M. homalotae*, this character being very variable. The supposed "unilaterality" of the thallus in this species is not consistent, and normal, bilaterally symmetric thalli are abundant among the specimens included on the type slide (fig. 4). Therefore, I conclude that *M. unilateralis* should be regarded as a synonym of *M. homalotae*.

Monoicomyces venetus Spegazzini, Anales Mus. Nac. Hist. Nat. Buenos Aires 27: 69 (1915)
The slide examined is labelled as follows: "IN CAPITE STAFILIN ... / CONEGLIANO / VII-1913 / LPS 45062 / TIPO".

This slide contains only one mature specimen (fig. 5). This species is very different from the other two herein studied. *Monoicomyces venetus* seems to be a well distinguished species: primary appendage unbranched, short, and amber-coloured as in the remainder of the thallus; perithecium with the outer walls arranged in spiral rows; base of the perithecial stalk cell dark and constricted. Therefore, this species may be

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Fig. 1. *Monoicomyces ternatus* (LPS·45061). Sintype. **Figs. 2-4**. *Monoicomyces unilateralis* (LPS·45087). Type specimens. **Fig. 5**. *Monoicomyces venetus* (LPS·45062). Type specimen. (Scale bars = 50 μm. Scale bar in fig. 2 is the same for the figs. 3, 4 and 5.)

1

2

3

4

5

retained as a separate species.

The author wishes to express his gratitude to Angélica Arambarri (director of "Instituto de Botánica C. Spegazzini") for the loan of Spegazzini types, and to I.Tavares for critical reading of the manuscript.

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OBSERVATIONS ON PSEUDOTRACYLLA SPECIES

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ABSTRACT

Pycnothyrial formation and sporulation in *Pseudotracylla dentata* is described from a collection on dead leaves of *Vaccinium macrocarpon* (cranberry) from a cultivated bog in Massachusetts. This is the first report of *P. dentata* since its description in 1976 on *Eucalyptus* leaves in Brazil. The geographic range of *P. falcata*, described in 1992 from dead cranberry leaves in Massachusetts and New Jersey, is expanded with the discovery of the fungus on dead leaves from two cranberry bogs in Wisconsin.

Key Words: cranberry microfungi, *Pseudotracylla dentata*, *Pseudotracylla falcata*, pycnothyrium, *Vaccinium macrocarpon*

The pycnothyrial genus *Pseudotracylla* Sutton & Hodges (1976) was based on a single collection of *Eucalyptus citriodora* Hook. leaves from Brazil. *Pseudotracylla dentata* Sutton & Hodges, the type species, is characterized by fusiform conidia and a dentate margin on the upper pycnothyrial wall. *Pseudotracylla* remained monotypic until Carris (1992) described *P. falcata* Carris from dead leaves and decayed fruit of *Vaccinium macrocarpon* Ait. (cranberry) from Massachusetts and New Jersey. *Pseudotracylla falcata* differs from *P. dentata* in having a smooth margin on the upper pycnothyrial wall and distinctly falcate conidia. An unusual type of conidiomatal development was described in *P. falcata* in which a central, flattened, lobed cell expands outward, forming septa that delimit individual cells. This single layer of cells eventually forms both the upper and lower walls of the pycnothyrium. The limited amount of material in the type collection of *P. dentata* precluded a precise description of conidiomatal development in that species. Recently, *P. dentata* was found on dead cranberry leaves from a commercial cranberry bog in Massachusetts. The fungus was established in pure culture in order to compare sporulation with that observed in *P. falcata*. Pycnothyria on cranberry leaves were fixed and sectioned to compare conidiomatal structure with the earlier report on *P. falcata* (Carris, 1992).

MATERIALS & METHODS

Leaves of *V. macrocarpon* were collected from piles of debris in cultivated bogs in Massachusetts and Wisconsin during October and November, 1990 and 1991. Leaf samples were stored in plastic bags at 5 C for up to three months. Production of conidia was stimulated by placing leaves with pycnothyria in a moist chamber for one or more weeks. Conidia were streaked onto Difco Bacto-agar and subcultures made from single, germinating conidia. Isolates were grown in 9-cm diam plastic Petri dishes on Difco corn meal agar (CMA) under artificial light and temperature (20-25 C). Conidiomata were fixed and sectioned at 8 μm as previously described (Carris, 1992). Cultures were deposited in ATCC, CBS and IMI, and dried specimens were deposited in IMI and WSP.

RESULTS

Pseudotracylla dentata was found in leaf debris samples from one of 24 cultivated cranberry beds surveyed in Massachusetts. *Pseudotracylla falcata* also was present in this sample. Pycnothyria of one or both species of *Pseudotracylla* were found on 70% of the leaves examined. *Pseudotracylla falcata* was present on 56% of the colonized leaves, *P. dentata* on 22%, and pycnothyria of both species were present on the remaining 22% of the colonized leaves. *Pseudotracylla falcata* was found in leaf debris samples from two of twelve cultivated cranberry beds sampled in Wisconsin, expanding the known geographical range of this fungus. *Pseudotracylla dentata* was not found in any of the Wisconsin samples. Neither species has been found in cultivated cranberry bogs in Oregon and Washington. The Massachusetts cranberry isolate of *P. dentata* agrees with the published description (Sutton and Hodges, 1976) and type material (IMI 196483k). The Wisconsin isolates of *P. falcata* were indistinguishable from the holotype (WSP 69554) and other isolates from Massachusetts and New Jersey. The reader is referred to Carris (1992) for a description of this fungus on host tissue and in culture. A description of *P. dentata* on host material and in culture follows.

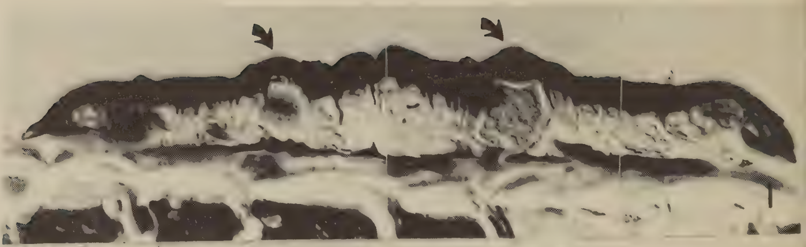
Conidiomata on host tissue 48-132 μm diam, formed singly or coalescing on lower leaf surface. Conidiomata superficial, attached to the leaf by a single, narrow hypha penetrating the host epidermis. Conidioma composed of septate upper wall connected to lower, membranous wall by central columella (Fig. 1). Upper wall of conidioma (Figs. 2, 4) dark reddish brown, composed of one central, globose-angular cell (= columella) 6.2-8.8 x 5.3-7.9 μm diam; columella surrounded by 2-3 irregular rows of smaller globose-angular cells (= conidiogenous cells) 4.4-5.3 x 2.6-4.4 µm; these cells merging into outwardly radiating, square to rectangular cells (2.6-5.3 x 1.8-3.5 µm); terminating in a dentate margin. Lower wall dark brown, membranous, composed of radial rows of sparsely septate cells 1.8-3.5 µm diam (Fig. 3).

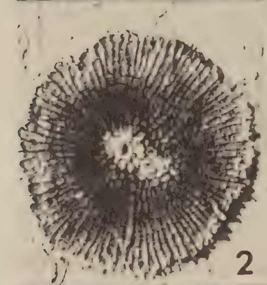
One-week-old colony on CMA 10-12 mm diam, with sparse, hyaline, mostly submerged hyphae 2.7-6.3 µm diam, with numerous clusters of dark cells submerged and on surface of agar (Fig. 5); clusters formed on surface of agar developing radiating, white aerial hyphae (Fig. 6). Conidiogenous cells enteroblastic-phialidic, of two types: first type hyaline, ampulliform to cylindrical, walls smooth, 6.3-13.5 x 2.6-4.1 µm, with prominent, cylindrical collarettes 1.8-3.5 µm deep and 2.6-3.5 µm wide, occasionally with percurrent proliferation resulting in annellations, formed singly or on branched conidiophores (Figs. 8, 9); second type dark brown, globose to ampulliform, becoming lobed, walls roughened, 5.3-8.8 x 4.4-7.9 µm, with inconspicuous collarettes, formed in clusters up to 850 µm diam (Fig. 10). Conidiogenous cells developing into clusters of lobed cells which form either irregular masses, or radiating shield-like structures reminiscent of upper wall of pycnothyrium. Similar conidia produced by both types of conidiogenous cells: hyaline, smooth, aseptate, fusiform, apex tapered, base truncate, with inconspicuous gelatinous appendage, 10.6-12.3 x 2.6-4.1 µm (Fig. 7), formed abundantly and accumulating in gloeoid mass around conidiogenous cells, germinating readily via single germ tube.

SPECIMENS EXAMINED: *Pseudotracylla dentata*, on leaves of *Eucalyptus citriodora*, Brazil, Paulista, Pernambuco, 30-VI-1975 (HOLOTYPE: IMI 196483K); on leaves of *Vaccinium macrocarpon*, Massachusetts, Plymouth County, South Carver, Wankinquoah Bog, 10-X-1990, *F. Caruso* (WSP 69558; IMI 352172).

ADDITIONAL SPECIMENS EXAMINED: *Pseudotracylla falcata*, on leaves and decayed fruit of *Vaccinium macrocarpon*, Wisconsin, Monroe County, Potter Cranberry Company, 7-XI-1991, *S. N. Jeffers* (WSP 69586); Russell Rezin & Sons, Inc., 7-XI-1991, *S. N. Jeffers* (WSP 69587).

Colonies of *P. dentata* are white and composed of hyaline mycelium, whereas those of *P. falcata* are composed of dark brown mycelium. Both species produce clusters of dark brown conidiogenous cells, although the cells forming in cultures of *P. dentata* are mostly lobed, and in *P. falcata* are globose. The hyaline conidiogenous cells with prominent collarettes which were common in *P. dentata* cultures were not observed in *P. falcata*. Growth rate of *P. falcata* colonies was approximately twice that of *P. dentata*. When the two species were





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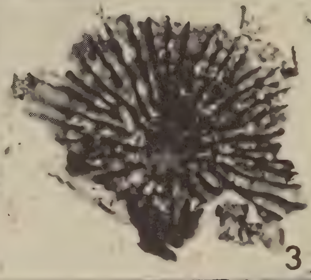

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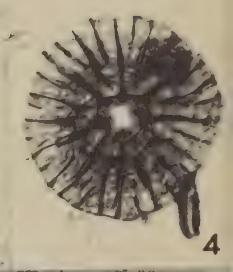

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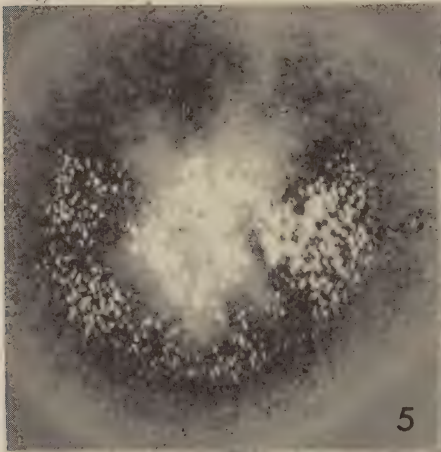

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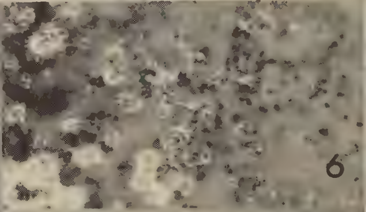

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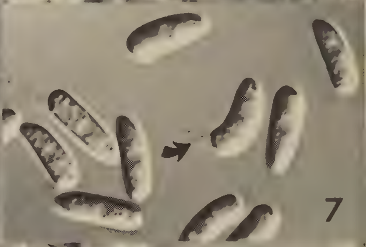

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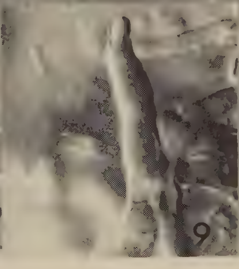

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paired in culture, mycelium of *P. falcata* would eventually grow completely around the slower growing colony of *P. dentata* without overgrowing mycelium of the latter species.

DISCUSSION

Examination of the *P. dentata* isolates on cranberry leaves substantiates the previous description of pycnothyrial structure in *Pseudotracylla* which was based primarily on *P. falcata* (Carris, 1992). In their original description of *P. dentata*, Sutton and Hodges (1976) had described the upper pycnothyrial wall as sparsely septate and the lower wall as composed of pseudoparenchyma. Hyphae composing the upper wall of mature pycnothyria of *P. dentata* examined in this study were regularly septate, whereas the lower wall was sparsely septate and membranous. The membranous nature and sparse septation of the lower wall (Fig. 4) suggest that it separated from the upper wall during an early stage of pycnothyrial development when the upper wall was still expanding.

The conidia produced in culture by the two types of conidiogenous cells in *P. dentata* are indistinguishable. In contrast, the conidia of *P. falcata* are only formed in culture from aggregations of dark, thick-walled conidiogenous cells (Carris, 1992). The aggregates of conidiogenous cells in *Pseudotracylla* species presumably represent an early stage in pycnothyrial formation, although fully-developed pycnothyria are rarely formed in agar culture. It is possible that pycnothyria develop in response to contact with a specific type of surface, such as the leaf cuticle. *Pseudotracylla dentata* is similar to *Tubakia* species in culture; both form conidiogenous cells in aggregations and singly on hyphae (Glawe and Crane, 1987). Munkvold and Neely (1991) questioned the

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Figs. 1-10. *Pseudotracylla dentata*. 1. Two mature pycnothyria grown together on leaf, longitudinal section (8 μm thick). Arrows indicate columellae. X 800. 2. Upper wall of pycnothyrium, treated with NaOCl. X 320. 3. Lower wall of pycnothyrium. X 640. 4. Upper wall of developing pycnothyrium. X 640. 5. 11-da-old colony on corn meal agar. X 5. 6. Clusters of dark conidiogenous cells produced on surface and submerged in agar, 11-da-old colony on corn meal agar. X 19. 7. Conidia produced in culture. Arrow indicates gelatinous sheath at base of conidium. X 1350. 8, 9. Hyaline conidiogenous cells produced in culture. X 1350. 10. Clusters of dark conidiogenous cells produced in culture. X 1350.

placement of these types of fungi in the Coelomycetes since their conidiomata are not true pycnidia or acervuli, and they grow like Hyphomycetes in culture.

This report of *P. dentata* on cranberry leaf debris in Massachusetts is notable in several regards. First, it is only the second time the fungus has been found, and the first time it has been cultured. Secondly, the occurrence of both known species of *Pseudotracylla* on cranberry, at the same site, and indeed, on the same leaf, suggests some type of host or habitat preference in the genus. However, as was previously noted, the type collection of *P. dentata* is from *Eucalyptus* leaves in Brazil. The existence of any similarity between the Brazil and Massachusetts habitats and the *Eucalyptus* and *Vaccinium* hosts is not obvious. Disparate host and geographical records such as this may be more due to the inconspicuous nature of the fungi and our lack of knowledge on them rather than to the actual distribution of species.

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ACAULOSPORA EXCAVATA SP. NOV. - AN ENDOMYCORRHIZAL FUNGUS FROM COTE D'IVOIRE

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SUMMARY

A newly discovered endomycorrhizal fungus, *Aucaulospora excavata*, is described and illustrated.

INTRODUCTION

As part of a study of spore populations of arbuscular mycorrhizal fungi in Côte d'Ivoire (Wilson *et al.* 1992), soil samples were collected from beneath *Terminalia superba* Engl. & Diels and *T. ivorensis* A. Chev. in the Mopri Forest Reserve, in October 1990. Among the spore types extracted was a previously undescribed member of the genus *Acaulospora* Gerdemann and Trappe. This fungus is described herein as *Acaulospora excavata* sp. nov.

MATERIALS AND METHODS

Spores were extracted from soil by sucrose centrifugation (Walker *et al.* 1982) and suspended in water for initial examination under a dissecting microscope (x 6-50). Illumination was by incident light from an quartz-iodine fibre-optic source with a colour temperature of 3200°K. Spore colour was described from freshly extracted spores suspended in water in plastic Petri dishes and illuminated by the same light source used for examining the spores. Colour was determined by comparison with a standard colour chart (Anon. 1969), the numbers following the colour descriptions refer to those given in the colour chart. Colour matching of structures viewed with transmitted light under a compound microscope was more difficult than with a dissecting microscope, so for such observations colours (for example, of individual walls in the description) were not precisely matched to a chart, and only generalised colour descriptions are used (Walker *et al.* 1993).

Specimens were mounted in polyvinyl alcohol lacto-glycerol (PVLG) (Koske & Tessier 1983) or distilled water (Spain 1990) with or without Melzer's reagent (Morton 1986a) for further study under a compound microscope (x 150-1500) with brightfield and Nomarski differential interference contrast illumination.

Wall structures were described using the standardized terminology and murographs of Walker (1983) and Morton (1986b). So far, attempts to establish this species in pot culture have failed.

ACAULOSPORA EXCAVATA Ingleby and Walker sp. nov. (Figs 1 & 2)

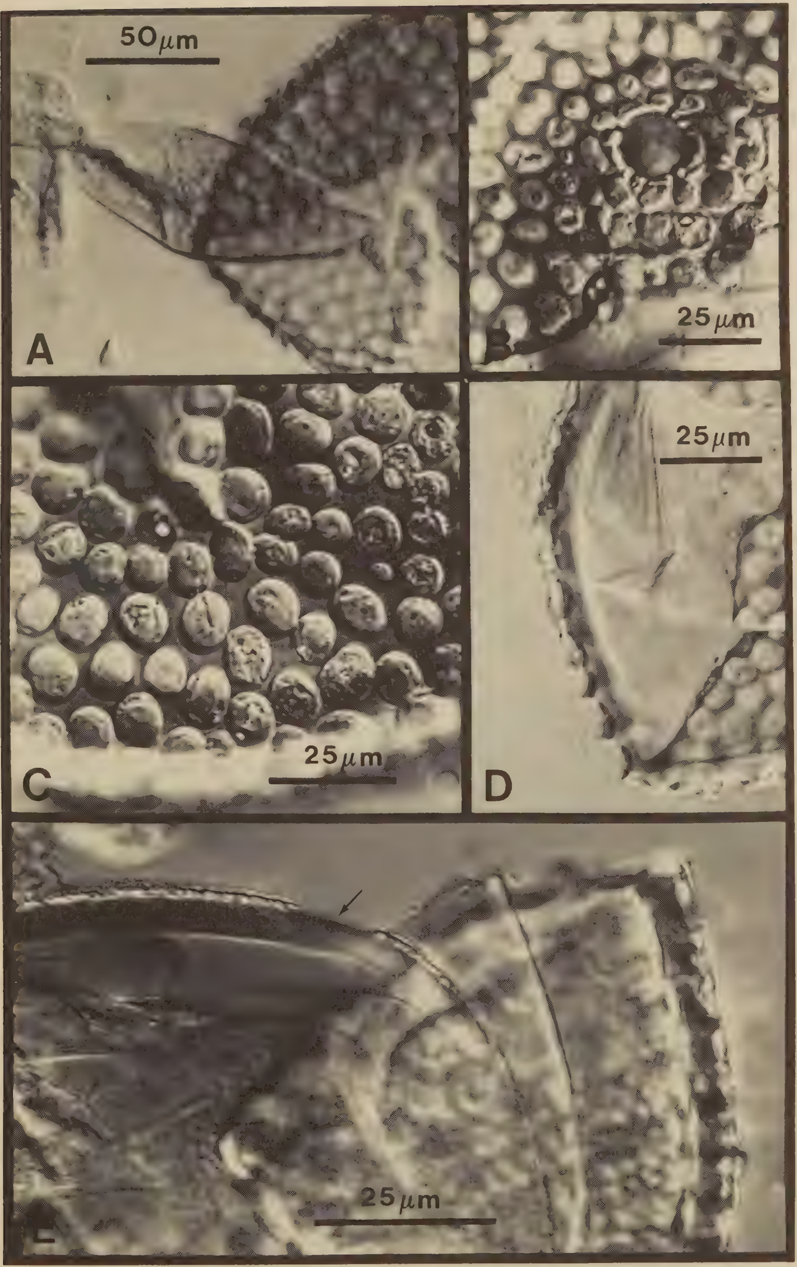
Sporae singillatim in terra enatae, lateraliter gestae in sacculo sporifero, pallide ochraceae, ochraceae vel aurantiae, globosae vel subglobosae, 115-200 x 100-165 µm. Sporarum tunicae 3 in turmis tribus: Turma A cum tunica singula, colorata, 8-11 µm crassa, foveis interdum leviter angularibus, 4-20 x 4-16 µm in diam et 2-6 µm profundis; turma B cum tunica singula, hyalina, membranacea, 0.5-1.0 µm crassa; turma C cum tunica singula, amorpha, baccata, 1-2.5 µm crassa, in solutione Melzeri carnea vel purpurea.

SPORES borne singly in the soil laterally on the neck of a hyaline sporiferous saccule that collapses after the spores mature; spores pale ochraceous (6) to ochre (9) to orange (48); globose to subglobose, 115-200 x 100-165 µm.

SACCULE neck at point of attachment to the spore 9-19 µm in diameter with walls 1-2 µm thick (Figs. 1A, 1B). Dimensions of saccule not determined.

WALL GROUP A of a single, pale yellow, laminated wall, 8-11 µm thick, not reacting to Melzer's reagent. Outer surface ornamented by circular to subcircular to elliptical pits, 4-20 x 4-16 µm in diameter and 2-6 µm in depth sometimes with a slightly angular outline (Figs. 1C, 1D). These pits appear flat-bottomed with the basal area 3-15 x 3-12 µm in diameter (Fig. 1C, arrowed). Pits adjacent or up to 9 µm apart.

Fig. 1. Light photomicrographs of spores of *Aucaulospora excavata.*
A. Saccule neck still attached to spore.
B. Saccule scar. Note the smaller pits immediately surrounding the scar.
C. Surface view of ornamented outer wall showing pit size, shape and distribution. These pits are flat-bottomed and in some cases the basal perimeter is in focus (arrowed).
D. A fractured spore showing the pits in cross-section.
E. A fractured spore showing all three walls. Note the beaded inner wall 3 which has expanded in PVLG and the area where the beaded deposition is absent (arrowed).


50μm
A
25μm
B
25μm
C
25μm
D
25μm
E

SPORE WALL STRUCTURE of three walls (1-3) in three wall groups (A-C) (see Murograph Fig. 2).

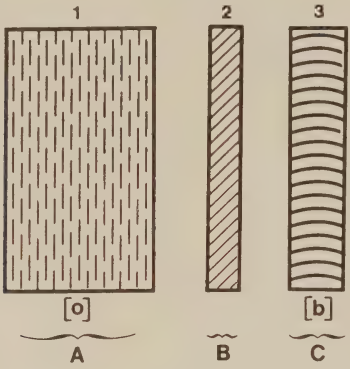


Fig. 2 Murograph (after Walker 1983) of *Acaulospora excavata*.

WALL GROUP B of a single, hyaline, membranous wall, 0.5-1.0 μm thick, not reacting to Melzer's reagent (Fig. 1E).

WALL GROUP C of a single 'beaded', amorphous wall, 1-2 μm thick (including beaded ornamentation on outer surface), which reacts strongly in Melzer's reagent turning pink or purple within minutes of crushing the spores. This wall is plastic in PVLG and, when crushed, may become up to 9 μm thick (Fig. 1E).

ETYMOLOGY: Latin *excavata* - referring to the appearance of the pits on the outer wall.

DISTRIBUTION AND HABITAT: Known only from a single soil sample collected from the Mopri Forest Reserve. The sampling area was one of natural forest which had been manually cleared and burnt in 1989 before replanting with *T. ivorensis*. This disturbance had resulted in marked changes in soil chemistry with increases in pH (from 6.5 to 7.5), organic matter and available nutrients; at the sample point where *A. excavata* was found the pH was particularly high (8.2). Changes in vegetation also occurred after the clearance. In addition to planting with *T. ivorensis* the plot was rapidly colonised by a wide range of herbaceous species, most notably *Chromolaena odorata* (L.) King & Robinson.

MYCORRHIZAL ASSOCIATIONS: Not known. Baiting out the species was attempted by both single-spore and multi-spore isolation and open-pot culture (Gilmore 1968) using *Plantago lanceolata* L. and *Vigna unguiculata* (L.) Walp. as host plants. None of these attempts succeeded.

HOLOTYPE: Cote d'Ivoire: South West of Tissale - Mopri Forest Reserve under *Terminalia ivorensis*, E; isotype OSC (Walker 1674. 30 X 90).

DISCUSSION

Spores of *A. excavata* possess a distinctly ornamented outer wall surface of densely crowded, flat-bottomed pits. Six other species of *Acaulospora* have been described so far which possess a distinctly pitted outer wall, namely *Acaulospora foveata* Trappe and Janos (Janos & Trappe 1982), *A. cavernata* Blaszkowski (Blaszkowski 1989), *A. lacunosa* Morton (Morton 1986b), *A. paulinae* Blaszkowski (Blaszkowski 1988), *A. undulata* Sieverding (Sieverding 1988) and *A. scrobiculata* Trappe (Trappe 1977).

Spores of *A. foveata* can be distinguished from *A. excavata* by their generally larger size (185-310 x 215-350 μm) and colour (yellow/brown to red/brown to black/brown). Spores of *A. paulinae* are smaller (60-95 μm) and those of *A. scrobiculata* are a paler colour (hyaline to olive to brown) while those of *A. undulata* are both smaller (55-85 μm) and are a paler colour (hyaline) than those of *A. excavata.* We have not been able to examine spores of *A. cavernata* , but from their description, they are similar in size and colour to those of *A. excavata.*

From their descriptions, *A. cavernata, A. lacunosa, A. paulinae* and *A. scrobiculata* have smaller pits than *A. excavata* (always < 6 μm diam compared with 4-20 x 4-16 μm) and thinner outer walls (< 6 μm thick compared with 8-11 μm). Pits of *A. lacunosa, A. paulinae* and *A. scrobiculata* are also more widely spaced and irregularly shaped. Additionally spores of *A. cavernata* are described as having a second wall in wall group A and a coriaceous wall in wall group C while those of *A. lacunosa* have a second wall in wall group B. Spores of *A. undulata* possess an even thinner ornamented wall (1-1.5 μm thick) consisting of depressions separated by ridges 1 μm wide. They are also described as having an outer evanescent wall, though examination of specimens from the type culture does not show this phenomenon. Although *A. excavata* and *A. foveata* have similar sized pits, the smaller spore size and more densely crowded pits of *A. excavata* combine to give the surface of the outer wall a completely different appearance to that of *A. foveata.*

Wall group C of *A. excavata* is described as a single beaded wall, though it can appear as two walls in PVLG mounts. The depositions on the outer surface of this amorphous wall clearly do not constitute a distinct wall, though in places they are so crowded as to seemingly form a separate layer. In other places, however, the beads may be absent, possibly due to detachment during crushing (Figure 1E, arrowed).

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STUDIES ON KERATINOPHILIC FUNGI. II. *CHRYSOSPORIUM PILOSUM sp. nov.*

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ABSTRACT

Chrysosporium pilosum *sp. nov.*, a keratinophilic hyphomycete isolated from river sediments and soil, is described. The fungus is characterized by its restricted growth on agar media at 25/37 °C and the production of conidia on deflected short protrusions, but its most prominent feature is the presence of broad, simple, thick-walled, brownish, sterile hyphae. The taxonomic position of the species is discussed.

RESUMEN

Se describe un nuevo hifomiceto keratinofílico, ***Chrysosporium pilosum*** *sp. nov.*, a partir de tres cepas aisladas de sedimentos fluviales y de suelo. Dicho hongo se caracteriza por presentar un crecimiento restringido en cultivo a 25/37 °C, por la producción de conidios a partir de cortas protuberancias, a menudo curvadas, y por la existencia de hifas estériles de color pardo. Se discute la posición taxonómica de esta especie.

In our studies on keratinophilic fungi from different sources, many species of taxonomic interest have been isolated. One of them, ***Chrysosporium pilosum*** *sp. nov.*, is described and illustrated below.

Chrysosporium pilosum Gené, Guarro *et* Ulfig *sp. nov.*

Etym.: referring to the sterile and brown hyphae.

Coloniae in agaro PYE ad 25 °C lente crescentes, elevatae, in medio convolutae, frequenter in margine radiato-striatae, luteolae vel subbrunneae, floccosae vel coactae, margo definitus, leviter lobulatus; reversum brunneoaurantiacum vel fuscum. 37 °C crescit. Hyphae vegetativae hyalinae vel albolutae, ramosae, septatae, tenuitunicatae, laeves, 1-2.5 µm crassae; post 2-3 hebdomades hyphae steriles formantur, simplices, brunneae et crassitunicatae, 3-5.5 µm crassae. Hyphae reticulatae nonnumquam praesentes. Conidia terminalia et lateralia numerosa, oriunda ex brevibus protrusionibus vel ramulis lateralibus, rectis vel flexuosis, nonnumquam sessilia, solitaria, luteola, primum laevia et tenuitunicata, deinde verrucosa et crassitunicata, unicellularia, globosa, subglobosa vel pyriformia, raro fusiformia, 4-6 x 3.5-5.5 µm, cicatrice basilari 1.5-2 µm diam. Conidia intercalaria minus numerosa, solitaria, luteola, primum laevia et tenuitunicata, deinde verrucosa et crassitunicata, unicellularia, subglobosa, doliiformia, nonnumquam unilateraliter inflata, 3.5-5.5 x 3-4 µm. Chlamydosporae absentes. Species moderate keratinolytica. Reproductio sexualis ignota.

Holotypus: IMI 356294, *ex sedimentis fluvialibus.* **Isotypus**: FMR 4157.

On phytone-yeast extract agar (PYE) at 25 °C, colonies restricted, with a mean daily radial spread of 0.4-0.7 mm, raised up to 6 mm, smooth or convoluted at the centre, often radially folded at the periphery, yellowish-white to mustard-yellow, light brown in age, consisting of a basal felt covered by cottony to floccose aerial mycelium, often with droplets of colourless or light brown exudate, margin well-defined, slightly lobulate; reverse brownish-orange or dark brown. Sporulating slowly. Hyphae hyaline

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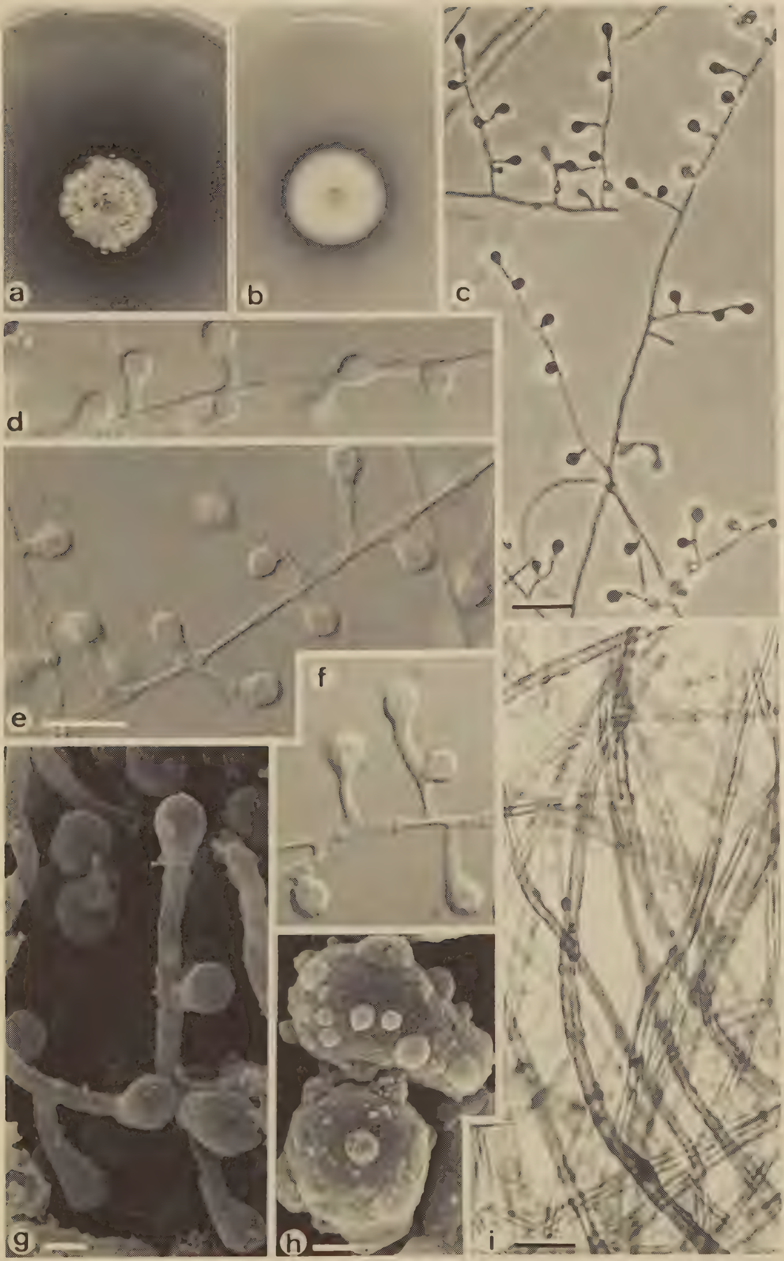
Fig. 1. ***Chrysosporium pilosum*** IMI 356294. a,b. Colonial morphology after 4 weeks at 25 °C (a. on PYE; b. on OMA). c-g. Fertile hyphae with terminal, lateral and some intercalary conidia (c. bar=20µm; d-f. bar=10µm; g. bar=2µm). h. Conidia (bar=1µm). i. Sterile hyphae (bar=20µm).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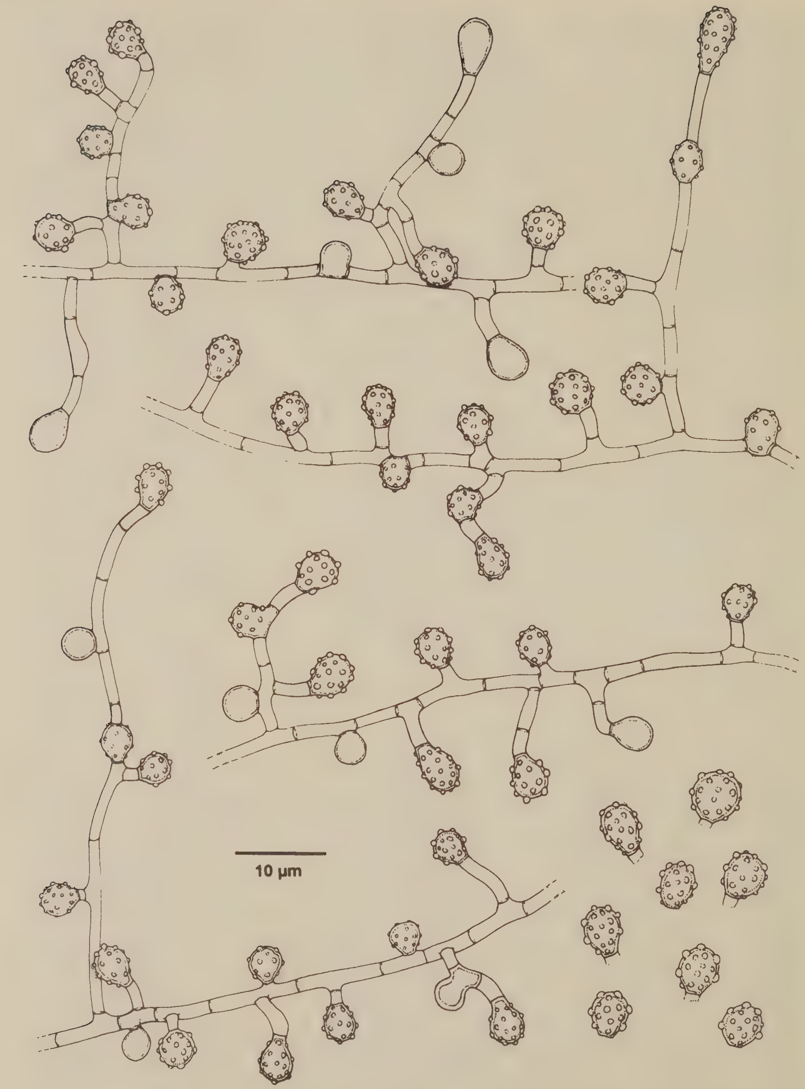

Fig. 2. ***Chrysosporium pilosum*** IMI 356294. Fertile hyphae and conidia.

to yellowish, branched, septate, smooth- and thin-walled, 1-2.5 μm wide; after 2-3 weeks (on all media tested) numerous, brown and thick-walled, sterile hyphae are present, especially in the centre of the colony. These hyphae are simple, straight or slightly wavy, sparsely septate, 3-5.5 μm wide, bearing irregular, darker brown knobs. Racquet hyphae occasionally present. Terminal and lateral conidia abundant, usually born on deflected short protrusions or on straight or flexuose side branches, sometimes sessile, solitary, hyaline to pale yellow, initially smooth- and thin-walled, becoming thick-walled and usually coarsely verrucose at maturity, unicellular, globose, subglobose to pyriform, in young cultures occasionally fusiform (IMI 356295), 4-6 x 3.5-5.5 μm, with basal scars 1.5-2 μm wide. Intercalary conidia often present (abundant in IMI 356295), solitary, pale yellow, at first smooth- and thin-walled, later becoming thick-walled and often coarsely verrucose, unicellular, subglobose to barrel-shaped, occasionally unilaterally inflated, 3.5-5.5 x 3-4 μm. Chlamydospores not observed. Teleomorph unknown.

On oat-meal agar (OMA), colonies with a mean daily spread of 0.6-0.7 mm, raised (3-4 mm), smooth, slighly depressed at the centre, densely cottony, pale yellowish, becoming light brown or brown at the centre due to dark hyphae, sometimes with colourless exudate droplets, margin defined, irregularly lobulate, slightly fimbriate; reverse reddish-orange or olive-brown, with the yellowish pigment diffusing into the medium. Sporulation abundant. With the strain IMI 356790, we obtained occasionally a structure similar to a hairy pseudoascomata but it was sterile.

The fungus grows at 37 °C, with mean daily radial spread of 0.3-0.4 and 0.6-0.7 mm on PYE and OMA, respectively. Colonies on PYE yellowish-white, raised up to 3-4 mm, slightly convoluted, with a basal felt covered by cottony to floccose aerial mycelium; margin defined, irregular; reverse colourless or light brown. On OMA, colonies yellowish-white, floccose and raised up to 2-4 mm at the centre, white, funiculose and radially folded at the periphery; margin defined, lobulate; reverse pale green, with the yellow pigment diffusing into the medium.

Resistant to cycloheximide 0.2 %. Slightly keratinolytic.

Material examined: IMI 356294 (=FMR 4157), from river sediments of the River Fluvià, Catalonia, Spain, 16 September 1991; IMI 356295 (=FMR 3972, RV 24220), from soil, Somalia, 14 March 1968; IMI 356790 (=FMR 4345), from forest soil, Guanajay, Pinar del Río, Cuba, 22 March 1992.

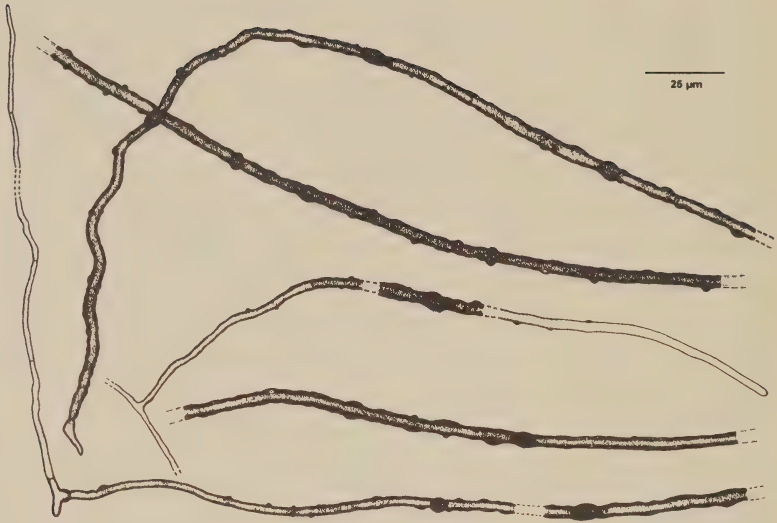

Fig. 3. ***Chrysosporium pilosum*** IMI 356294. Sterile hyphae.

The main characteristic of both isolates of *C.* ***pilosum***, unique for this genus, is the presence of brown, thick-walled hyphae, suggesting an ascomycete teleomorph. However, no ascomata could be obtained under a variety of growth conditions (different temperatures and media) and when the three strains were crossed with each other. Species with a similar characteristic are ***Onychocola canadensis*** Sigler *et* Congly (1990) and ***Malbranchea filamentosa*** Sigler *et* Carmichael (Sigler *et al.*, 1982). Both species have arthroconidia and in neither case did a teleomorph develop. Some other species of ***Chrysosporium***, such as *C.* ***merdarium*** (Link) Carmichael (1962), the *C.* anamorph of ***Amaurascopsis perforatus*** Guarro *et al.* (1992), the *C.* anamorph of ***Renispora flavissima*** Sigler *et al.* (1979), and *C.* ***vallenarense*** Oorschot *et* Piontelli (1985), resemble *C.* ***pilosum*** in having yellow pigmentation of the colonies as well as globose to obovoid and coarsely verrucose conidia. However, *C.* ***merdarium*** and *C.* ***vallenarense*** have a maximum temperature for growth of about 30 °C. In addition, the growth rate of the former is faster at 20 °C, and the conidia in the latter are often produced on sympodial branches. The ***C.*** anamorph of ***R. flavissima*** produces larger (5-12 x 4-12 μm), spiny or prominently tuberculate conidia, whereas that of ***A. perforatus*** has a faster growth at 37 °C, with a Magenta-coloured colony reverse on OMA, producing a teleomorph with peridial hyphae quite different from the sterile hyphae observed in ***C. pilosum***.

ACKNOWLEDGEMENTS

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A NEW SPECIES OF DELITSCHIA FROM WEST AFRICA

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Summary

A new species of *Delitschia* growing in culture is described and illustrated. The fungus was isolated from dung of a dassie collected in Namibia. It is characterized by having asci each with 64 ascospores. Also, each ascospore has a transverse and non-constricted septum, with a longitudinal germ slit.

Introduction

Species included in the genus *Delitschia* Auersw. are fimicolous loculoascomycetes, characterized by bitunicate asci and dark brown to black, two-celled ascospores. The septum is median, transverse or oblique, and both cells of the ascospore have an elongated germ slit. A hyaline gelatinous sheath surrounds each ascospore. The genus was last reviewed in 1975 by Luck-Allen and Cain (1), who recorded 46 species. Later, six more species were added (2,3). Of these 52 total species, only 6 produce asci with more than 8 ascospores, with the remainder having asci with 8 or less ascospores.

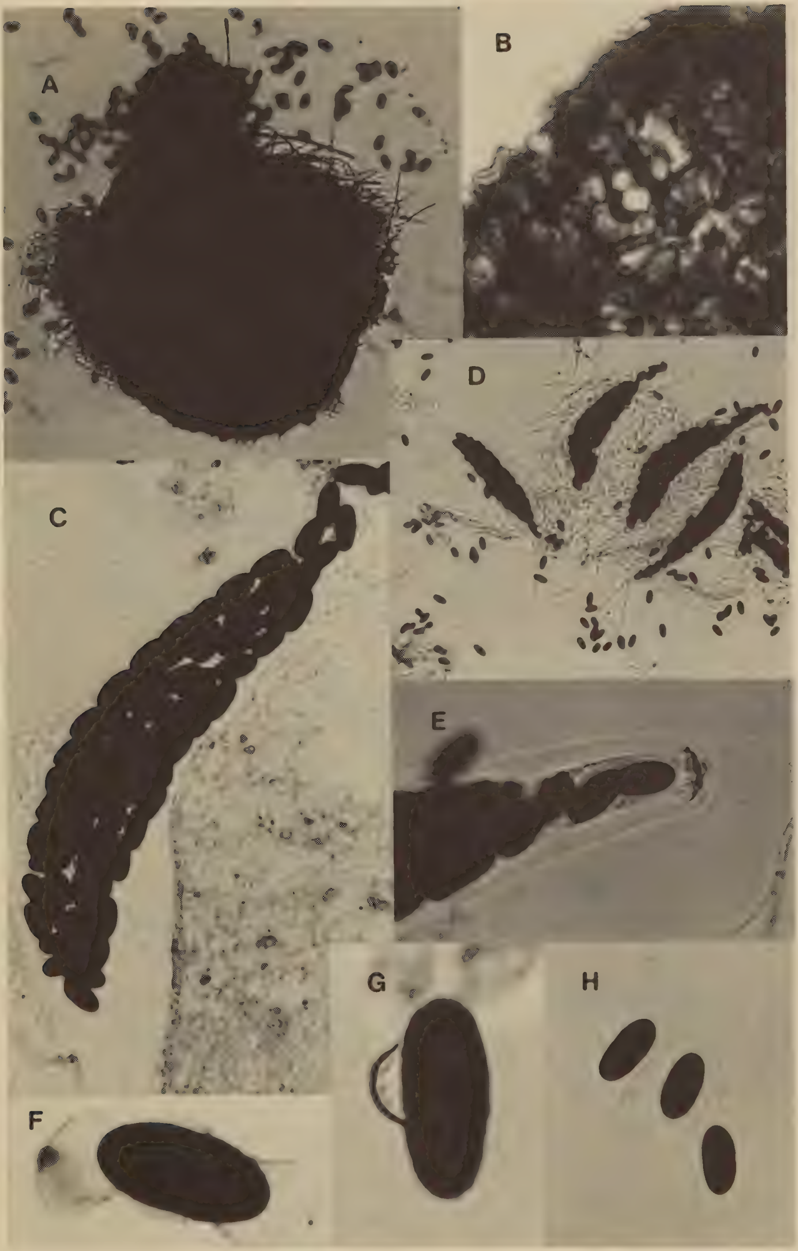
In this paper we describe a new species of *Delitschia* with approximately 64 ascospores per ascus isolated from dung of dassie (*Procavia sp.*) collected in Namibia. A key to the species of this genus having more than eight ascospores is also presented.

Materials and Methods

Isolation of the culture: 0.5 g of dried dung was ground and rigorously washed with water and air for 1 hour in a device with four screens decreasing in pore size, similar to the one described by Parkinson & Williams for the isolation of soil fungi (4). The particles retained in the smallest size screen (90-105 µm) were plated onto VDY medium, prepared according to Papavizas & Davey (5). The growing colonies were transfered to plates of potato dextrose and oatmeal agar for identification. Mature perithecia were observed after 2-3 weeks growing at 24°C under fluorescent light (near UV) on a 12 hour light/dark cycle.

In the descriptions capitalized color names in parentheses are from Ridgway (6). Cornmeal agar and V-8 juice agar were prepared as media M-7 and M-29, respectively, of Stevens (7). Potato dextrose agar and oatmeal agar were prepared media from Difco Laboratories.

Fig. 1. *Delitschia confertaspora*. A. Perithecium x 100. B. Peridium in surface view x 1200. C. Mature ascus x 320. D . Mature and immature asci, pseudoparaphyses and ascospores x 100. E. Upper portion of an ascus showing the double wall, the apical structure and mature ascospores x 500. F. Mature ascospore showing the transverse septum and the gelatinous sheath expanding about the ends of the spore x 1250. G. Mature ascospore showing the longitudinal germ slit x 1200. H. Mature ascospores with gelatinous sheath x 500.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Description of the species

Delitschia confertaspora Peláez, Polishook, Valldosera and Guarro, sp. nov. Figs. 1-2

Peritheciis subglobosis vel piriformibus sparsis, brunneis vel atrobrunneis, 400-625 x 350-625 µm, pilis hyalinis vel flavo-brunneis, septatis, 2-4 µm diam, collo papilliformi vel cylindraceo, 65-150 x 80-130 µm; peridio membranaceo vel aliquantum coriaceo, atrobrunneo, opaco; cellulis externis irregulariter angulatis vel epidermoideis. Ascis 64-sporis, cylindraceis vel clavatis, 250-365 x 37-57 µm, superne late rotundatis, brevi-stipitatis; pseudoparaphysibur numerosis, hyalinis, filiformibus, 0.8-4 µm diam, septatis. Ascosporis multiseriatis, brunneis vel atrobrunneis, opacis, ellipsoideis, 23-25 x 9-11 µm, transverse uniseptatis, leviter constrictis vel nonconstrictis, segmentis ascosporarum maturis sape sejuntis, strato mucoso hyalino involutis, stria germinal longitudinaliter prolata.

TYPO: In fimo ex dassie, Mirabeb Hills, Namibia, 23 Sept. 1990. Teges culta sicca IMI 350,692 (=ATCC 74209).

ETYMOLOGY: Latin, *conferta* = crowded or dense, *spora* = seed, referring to the arrangement and quantity of spores in the ascus.

Perithecia dark brown to black, subglobose to pyriform, 400-625 x 350-625 µm; irregularly covered with hyaline to pale brown, septate, mostly unbranched hairs, 2-4 µm in diam; scattered, solitary to aggregated, superficial; ascospores, when mature, extruded as black, slimy mass; neck dark brown, papillate to short cylindrical, 65-150 x 80-130 µm; peridium membranaceous to rather coriaceous, dark brown, opaque, consisting of irregularly, thick-walled cells, textura angularis to epidermoidea.

Asci usually 64-spored, bitunicate, cylindrical to clavate, broadly rounded above, tapering below into a short stipe, 250-365 x 37-57 µm.

Pseudoparaphyses numerous, hyaline, filamentous, septate, 0.8-4 µm in diam. Ascospores multiseriate, brown to dark brown, ellipsoidal, broadly rounded at the ends, 23-25 x 9-11 µm, transversely septate, 2-celled, unconstricted or only slightly constricted at the median septum and non separable at maturity,

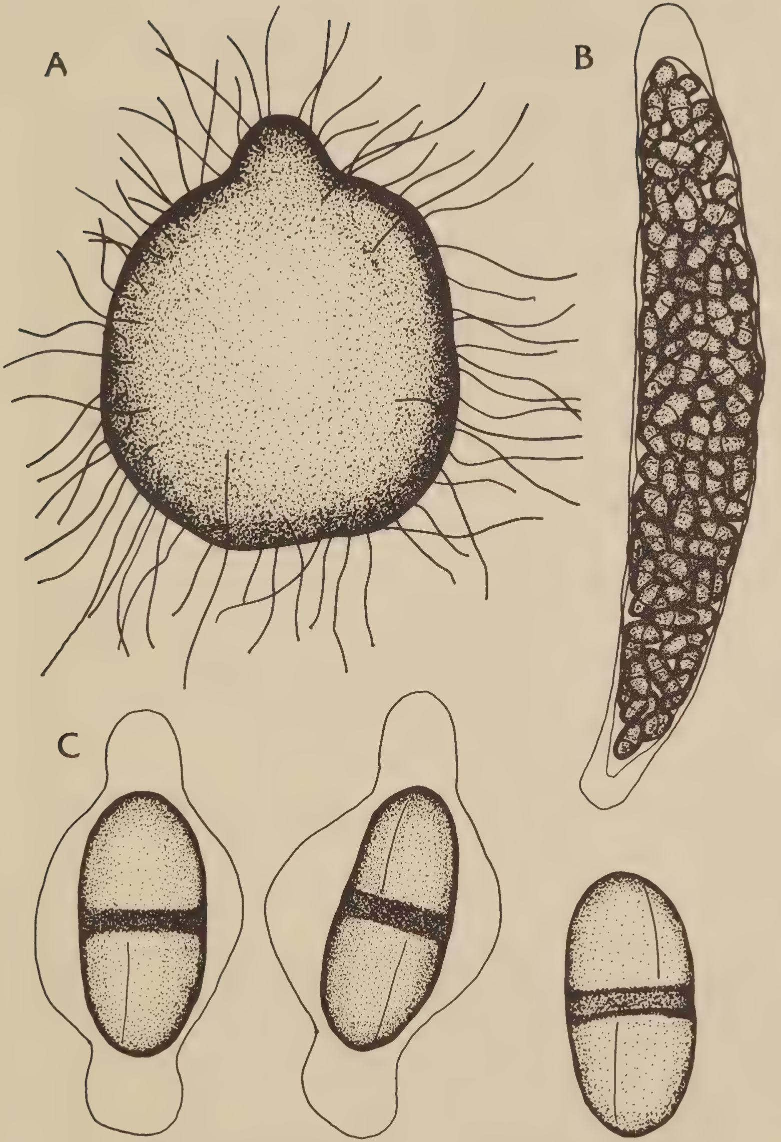

Fig. 2. *Delitschia confertaspora.* A. Perithecium. B. Ascus. C. Ascospores, two of them showing the gelatinous sheath. Bar: A = 140 µm; B = 35 µm; C = 10 µm.

each cell with a longitudinal germ slit, surrounded by an uneven hyaline gelatinous layer expanding up to 12 µm around the spore, wider on the ends of the spore than near the septum, and only visible in fresh preparations from young cultures.

CULTURAL CHARACTERISTICS: On cornmeal agar colonies growing moderately slow and submerged, attaining a diameter of 34 mm in 14 days at 25°C and 50% RH, margin uneven, surface appressed, sparse with margin dissected, culture mat near inoculum light brown (Clay Color, Cacao Brown) fading to colorless at margin, immature perithecia present.

On potato dextrose agar attaining a diameter of 41 mm, aerial mycelium cottony in colony center to a flat, mostly appressed margin, radially sulcate, margin uneven, color light orange-yellow (Light Ochraceous Buff, Ochraceous Buff) with a light gray (Dawn Gray) near the margin, reverse reddish brown (Burnt Sienna, Sandfords Brown), soluble pigment present, perithecia absent.

On oatmeal agar attaining a diameter of 41 mm, culture mat radially sulcate with some media buckling, mat near inoculum light brown (Light Ochraceous Buff, Ochraceous Buff), margin darker brown (Pecan Brown, Cinnamon), light yellow-brown exudate present at inoculum point, mature perithecia present.

On V-8 juice agar attaining a diameter of 44 mm, culture mat appressed or slightly raised, floccose to cottony at inoculum sometimes radiating to margin, color light brown (Flesh Ocher, Apricot Buff) with some sections with a gray tint (Hathi Gray), mature perithecia present.

HABITAT: On dung of dassie (*Procavia sp.*).

SPECIMEN EXAMINED: Mirabeb Hills, Namibia, Africa. 23 September 1990. Dried culture mat IMI 350,692 (=ATCC 74209).

Discussion

Delitschia confertaspora is characterized by having 64-spored asci, each ascospore with a longitudinal germ slit and a transverse and unconstricted septum. Only two other species of *Delitschia* with 64 ascospores per ascus have been previously described (2): *D. dochmiophragmia* and *D. spiralirima*. The species described here is easily distinguishable from these two.

The ascospores of *D. spiralirima* have a distinct spiral-shaped germ slit and are significantly larger in size (51-57 x 24-29 µm) than the ascospores of *D. confertaspora*, which have a longitudinal germ slit, and also the asci are much larger in *D. spiralirima* (450-600 x 130-150 µm).

In *D. dochmiophragmia* the ascospores have an oblique and constricted septum with each cell separating at maturity. *D. confertaspora*, however, has ascospores with a transverse septum, unconstricted or only very slightly constricted, and with the cells remaining intact at maturity. In addition, the ascospores of *D. confertaspora* are slightly smaller in size than *D. dochmiophragmia* (27-39 x 12-15 µm), and with the ends more broadly rounded than in this last species.

Finally, the gelatinous sheath that surrounds each ascospore of *D.confertaspora*, expanding about the ends, is clearly distinguishable from the other two species mentioned. However, it resembles the sheath of *D. mesostenospora*, although this species has eight-spored asci.

The following key discriminates among the described species of *Delitschia* with more than eight ascospores per ascus.

1. Asci with 16 ascospores 2
1. Asci with more that 16 ascospores 3

2. Ascospores with septum transverse; 56-62 x 18-21 µm
.... *D. polyspora* Griff.
2. Ascospores with septum oblique; 36-54 x 12-15 µm
.... *D. sexdecimspora* Jeng, Luck-Allen & Cain

3. Asci with 32 asci........................ *D. ionthada* Jeng, Luck-Allen & Cain
3. Asci with more than 32 ascospores 4

4. Asci with 64 ascospores 5
4. Asci with 256 ascospores .... *D. myriaspora* Breton & Faurel

5. Ascospores oblong with spiral shaped germ slit
.... *D. spiralirima* Jeng, Luck-Allen & Cain
5. Ascospores ellipsoidal with longitudinal slits 6

6. Ascospores obliquely septate
.... *D. dochmiophragma* Jeng, Luck-Allen & Cain
6. Ascospores transversely septate .... *D. confertaspora sp. nov.*

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MYCOTAXON

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A NEW SPECIES OF MARAVALIA FROM INDIA

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The genus **Maravalia** Arth. is characteristic in the possession of subepidermal, erumpent telia, with pedicillate, one celled, thin walled, non resting teliospores found successively on laterally free basidiogenous cells (Cummins & Hiratsuka, 1983). So far 31 species of **Maravalia** are reported (Ono, 1984) on members belonging to various angiospermic families viz., Acanthaceae, Erythroxylaceae, Euphorbiaceae, Leguminosae, Periplocaceae, Rubiaceae, Sapotaceae and Verbenaceae. Recently, the authors came across a hitherto undescribed species of **Maravalia** on **Tylophora** sp. (Asclepiadaceae) and the same is reported here.

Maravalia ramacharii John Ravinder & Bagyanarayana sp. nov. (Fig.1)

Spermagoniis et aeciis ignotis.

Urediniis hypophylliis, sparsis, raro aggregatis, sub-epidermalis, erumpentis, pulverulentis, pallide aurantiaco flavescentis, 0.7 - 1 mm crassa; urediniosporiis, pedicillatis, 18 - 27 x 12.4 - 18 um, ovatis, globosis vel ellipsoideis, membrana echinulata, hyalina, 2 um crassa, poris germinativis ignotiis.

Teliis hypophylliis, sparsis vel aggregatis 0.3 - 0.6 mm crassa, subepidermalis, erumpentis, teliosporiis 31 - 45 x 9 - 12.4 um, oblongo ellipsoideis, membrana 1.5 um crassa; pedicillatis, pedicello hyalinis, usque ad 21 um longis.

Holotypus : In foliis vivis **Tylophorae** sp., Dec. 1990, Narsapur (A.P.), India, John Ravinder, HCIO; Isotype PUR.

Etymology : In honour of late Prof. P. Ramachar, a reputed uredinologist of India.

Spermogonia and aecia not known. Uredinia hypophyllous, scattered, rarely aggregated, subepidermal, erumpent, pulverulent, light orange yellow, 0.7 - 1 mm diam; urediniospores pedicillate, 18 - 27 x 12.4 - 18 um, ovate, globose to ellipsoid, orange yellow when fresh, wall echinulate, hyaline, 2 um thick, germ pores absent.

Telia hypophyllous, scattered or aggregated in small clusters, 0.3 - 0.6 diam., subepidermal, erumpent; teliospores 31 - 45 x 9 - 12.4 um, oblong - ellipsoid, contents yellowish-orange when fresh, wall 1.5 um thick, hyaline, smooth; pedicillate, pedicel hyaline, upto 21 um long.

As per Ono's (1984) recent monograph on **Maravalia**, host genera belonging to Asclepiadaceae are not infected by species of **Maravalia**. However, **Cryptostegia** and **Pentopetia** belonging to Periplocaceae, a closely related family to Asclepiadaceae are infected by **Maravalia cryptostegiae** (Cumm.) Ono and **Maravalia** species. **M. ramacharii** does not bear any morphological resemblance to the **Maravalia** species reported on Periplocaceae.

The authors express their grateful thanks to Prof. Joe F. Hennen, Director, Arthur Herbarium and Head, Dept. of Botany & Plant Pathology, Purdue University for reviewing the manuscript and for helpful suggestions.

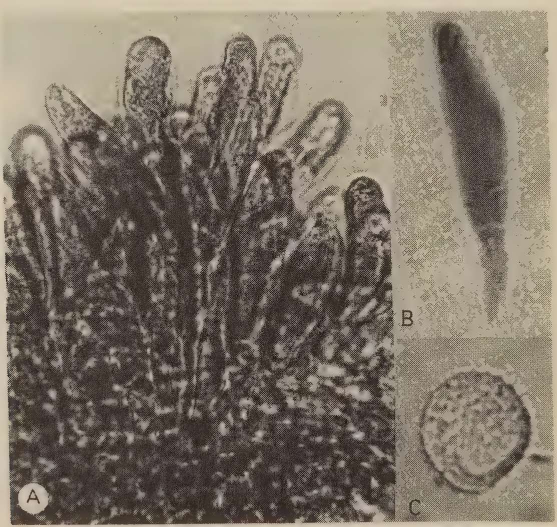

Fig. 1 **Maravalia ramacharii** sp. nov. (A) T.S. through the sorus showing teliospores (B) A pedicillate teliospore (stained with cotton blue) (C) An echinulate urediniospore.

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MYCOTAXON

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A NEW SPECIES OF UROMYCES ON OCIMUM FROM INDIA

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The family Labiatae (Lamiaceae) is known to have 3500 species distributed over 180 genera (Willis, 1982 Rev. by Airy Shaw). Nearly 55 of these genera consisting of 325 species are reported from India (Hooker, 1985; Gamble, 1957; Cooke, 1958). Of the **so** many genera **Ocimum** of the subfamily Ocimoideae is one of the most common genus occuring in wild as well as cultivated conditions. Recently, during a study of the rust fungus flora of Andhra Pradesh, the authors have collected rust infected plants of **Ocimum** sp. from Mannanore forest, Mahabubnagar Dist. (A.P.), India. A critical microscopic study revealed an undescribed species of Uromyces and the same is described here.

Uromyces ramacharii John Ravinder & Bagyanarayana sp. nov. (Fig. 1)

Spermagoniis et aeciis ignotis

Urediniis epiphylliis, subepidermalis, erumpentis, pulverulentis, cinnamomeo brunneis, 1-1.5 mm crassa; urediniosporiis pedicillatis, 16-23 x 15.5 - 18.6 um, globosis, subglobosis, ovatis vel ellipsoideis, membrana 1.5 - 2 um crassa, pallide flavescentis vel hyalinis, echinulatis, poris germinativis 2, equatorialibus.

Teliis amphigeniis, densus hypophylliis, atro-brunneis, sparsis vel aggregatis, subepidermalis, erumpentis, pulverulentis, 1 - 2 mm crassa; teliosporiis 21 - 32 x 18.6 - 21 um, globsis, subglobosis vel ovatis, membrana lateralis 3.5 - 5.4 um crassa, raro apicalis, 6.3 um crassa, verrucosis; pedicillatis, pedicello 15.5 - 45 um longis, hyalinis.

Holotypus : In foliis vivis **Ocimum** sp. (Labiatae), Mannanore forest, Mahabubnagar Dist. (A.P.), India Dec. 1990, Jagadeeswar and John Ravinder. HCIO. Isotype **PUR.**

Etymology : In honour of my (G.B.) revered teacher late Prof. P. Ramachar, a reputed Uredionologist of India.

Spermagonia and aecia not present. Uredinia epiphyllous, subepidermal, erumpent, pulverulent, cinnamon brown, 1 - 1.5 mm diam; urediniospores pedicillate, 16 - 23 x 15.5 - 18.6 um, globose, subglobose, ovate, ellipsoid, wall 1.5 - 2 um thick, pale yellow to hyaline, echinulate, germpores 2, equatorial.

Telia amphigenous, densely hypophyllous, blackish brown, scattered or aggregated, subepidermal, erumpent, pulverulent, 1 - 2 mm diam, teliospores 21 - 32 x 18.6 - 21 um, globose, subglobose, ovate, wall 3.5 - 5.4 um thick laterally, few spores are thick apically upto 6.3 um, chestnut brown, verrucose, pedicillate, pedicel 15.5 - 45 um long, hyaline.

The members of the family Labiatae are known to be parasitized by several rust fungi particularly the species belonging to the genus **Puccinia** (Sydow & Sydow, 1904; Arthur, 1934; Savulescu, 1953; Gaumann, 1959; Wilson & Henderson 1966). However, only 4 species of **Uromyces** viz., **U.prunellae** Schneid., **U.lamii** Kom, **U.ocimi** Hansford and **U.orthosiphoniis** Ramakri. & Srinivasan are reported. Of this Savulescu (1953) has listed **U.prunellae** as a synonym of **U.valerianae** (Schum.) Fuckel, a species known to parasitize, **Valeriana** of the family Valerianaceae but not Labiatae. With regard to **U.lamii**, Sydow & Sydow (1910) treated this as an excluded species because the so called host **Lamium amplexicaule** was found to be a species of **Euphorbia.** **U.ramacharii** is comparable with **U.ocimi** and **U.orthosiphonis** the two real species of **Uromyces** on Labiatae. **U.ocimi** differs from **U.ramacharii** in having only caulicolous telia, longer teliospores with a prominent apical thickness upto 9 um and a

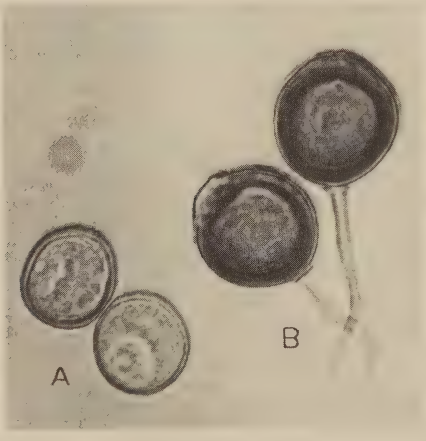

Fig. 1 **Uromyces ramacharii** sp. nov. (A) Echinulate urediniospores (B) Pedicillate teliospores.

fairly long (160 um) persistent pedicels. **U.ramacharii** differs from **U.orthospihonis** in lacking peripheral hyphoid paraphyses in the uredinia, comparatively smaller uridiniospores, and in having narrow but longer teliospores.

The authors express their grateful thanks to Prof. Joe F. Hennen, Director, Arthur Herbarium and Head, Dept. of Botany and Plant Pathology, Purdue University, for his kind help in reviewing the manuscript.

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MYCOTAXON

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AMANITA WESTII—TAXONOMY AND DISTRIBUTION. A RARE SPECIES FROM STATES BORDERING THE GULF OF MEXICO

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Summary

Amanita westii was described from Florida oak woods. Collections from Mississippi and eastern Texas extend its known range and allow for an improved description.

During his years in Florida, William A. Murrill was a prolific collector of fungi and described over 650 species of agarics and boletes as new. A number of these taxa have not been reported since he described them 40 or more years ago. One such species, the strikingly beautiful *Amanita westii*, was described by Murrill (1944) from a collection made by Murrill's associate Erdman West in Alachua County in 1938. The vegetation of the Gainesville, Florida area, where Murrill resided, is similar to that of the Gulf Coast region, and it may be surmised that the mycota would also be similar. It is from the Gulf Coast region that we report new collections of *A. westii*.

This unusual, large *Amanita* was rediscovered by Lewis during a 1987 collecting trip in eastern Texas. During the 1991 Gulf States Mycological Society summer foray, Ms. Toby Feibelman made a collection of *A. westii* in southern Mississippi. The latter collection included both mature specimens and ''buttons.'' Lewis studied both of these collections when fresh and photographed them. The holotype of *A. westii* has been studied previously by Bas (1969) and Jenkins (1979).

Methods and terminology follow those of Tulloss *et al.* (1992) and Tulloss (1993). We cite specimens deposited in the following herbaria:

- F - Herbarium, Field Museum of Natural History, Chicago, Illinois, U.S.A.
- FLAS - Herbarium, University of Florida, Gainesville, U.S.A.
- L - Rijksherbarium, Leiden, the Netherlands.
- RET - personal herbarium of R. E. Tulloss.

Color codes of the form ''7.5YR 8/6'' are from (Munsell Color, 1975). Color names in italics with first letters capitalized (*e.g.*, *Hair Brown*) are from (Ridgway, 1912).

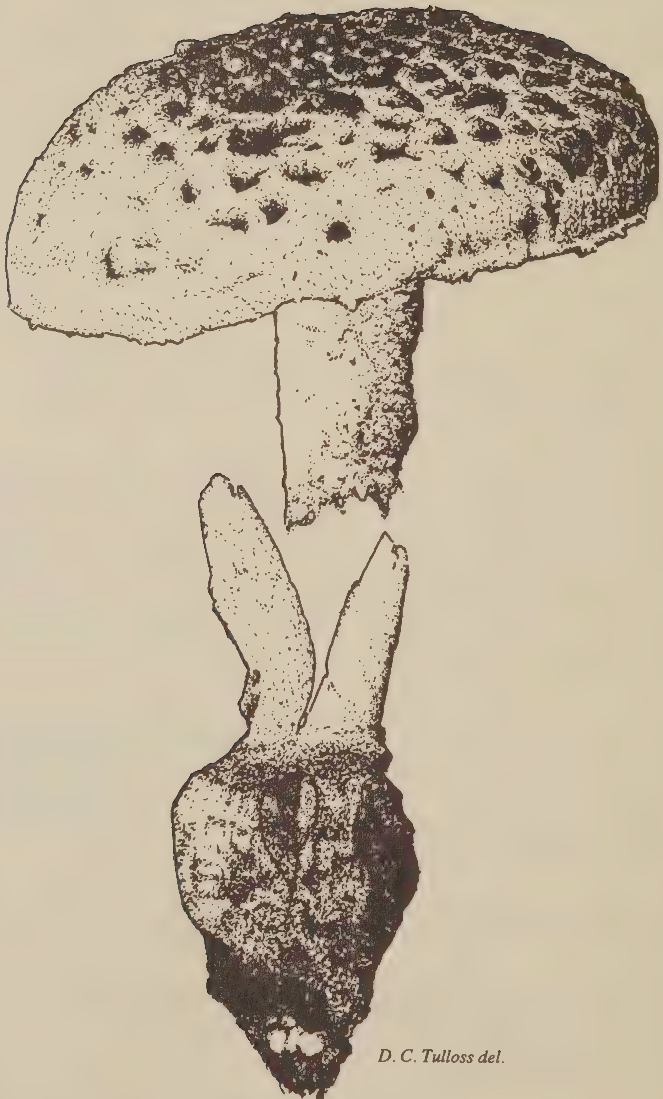

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Fig. 1. *Amanita westii* (Lewis 4074) habit (x0.7).

AMANITA WESTII (Murr.) Murr. 1944 [1945]. *Proc. Florida Acad. Sci.* 7: 127.

≡*Venenarius westii* Murr. 1944 [1945]. *Proc. Florida Acad. Sci.* 7: 115.
Illus.: Bas. 1969. *Persoonia* 5: 485, Figs. 244-246 [exsiccatum from holotype, universal veil elements, spores].

Amanita westii (Figs. 1-2) has a pileus densely set with pyramidal warts that are brown on the surface and white in the interior (at least in young material). The basidiocarp is prone to reddish bruising and staining similar to that exhibited by *A. rubescens* Pers. and has a slight odor of anise. The stipe has a radicating bulb. Dried specimens take on a deep wine-red color somewhat like that of exsiccata of *Lepiota americana* Peck.

PILEUS: 70 - 135$^+$ mm wide (largest pileus measured not fully expanded), convex to plano-convex, eventually planar, subviscid to dry, pale reddish brown (Murrill) to pale chocolate brown (Murrill), cracks between scales 10R 9/1 (near *Pallid Vinaceous Drab*), 10R 6/2 under warts, drying a dark wine color reminiscent of dried basidiocarps of *Lepiota americana*; *context* up to 20 mm thick at the stipe, white quickly bruising reddish brown or 7.5R 4/4 (near *Prussian Red*) changing to 10R 2/2 (near *Light Seal Brown*), eventually blackish, the color of cocoa powder in exsiccata; *margin* nonstriate, appendiculate with material hanging down 3 - 4 mm; *universal veil* as large warts, pyramidal to somewhat flattened (in the latter case often with a small central pimple), 2 - 4 mm high, with irregularly polygonal bases 3 - 5 x 8 - 10 mm, largest near pileus margin, densest over disk, 10R 2/2 (near *Light Seal Brown*), detersile.

LAMELLAE: adnexed by a line to stipe apex at first, then seceding, sometimes remote at maturity, rather crowded to close to subdistant, white at first, then gray white, finally reddish brown or 10R 6/2, drying reddish brown to dark brown, 11$^\pm$ mm broad, with edge thick and flocculose to fimbriate to almost crenate; *lamellulae* short, in one or two tiers, with the shortest subtruncate to somewhat rounded subattenuate, with the longest not distinguishable in exsiccata (notes from fresh material lacking).

STIPE: 70 - 155 x 15 - 35 mm, more or less cylindric or constricted at about the mid-point, covered at first with floccose-fibrillose material which adheres to the fingers, densely floccose to floccose-subfelted in apical region below partial veil, becoming undecorated, dry, originally whitish (sometimes becoming grayish) near apex, otherwise reddish brown or a very dark brown or pale reddish brown or 10R 6/2, concolorous with pileus in exsiccata; *context* white, with color changes on cutting or bruising as in pileus, solid; *bulb* obovoid-napiform to napiform to turbinate to broadly fusiform, radicating, occasionally abrupt to subabrupt, up to 40 - 45$^+$ x 30 - 50 mm, becoming colored like other parts; *partial veil* apical, subfelted to felted-submembranous, fragile, detersile or adhering to edges of lamellae, white at first, then pale reddish brown or 10R 6/2, striate above, underside densely flocculose; *universal veil* as fibrillose material (occasionally vague warts or felted patches) at stipe base and on upper half of bulb in ''button'' stage, detersile, colored as on pileus.

Odor faintly of anise (Murrill). *Taste* sweet and nutty at first, becoming slightly astringent (Murrill).

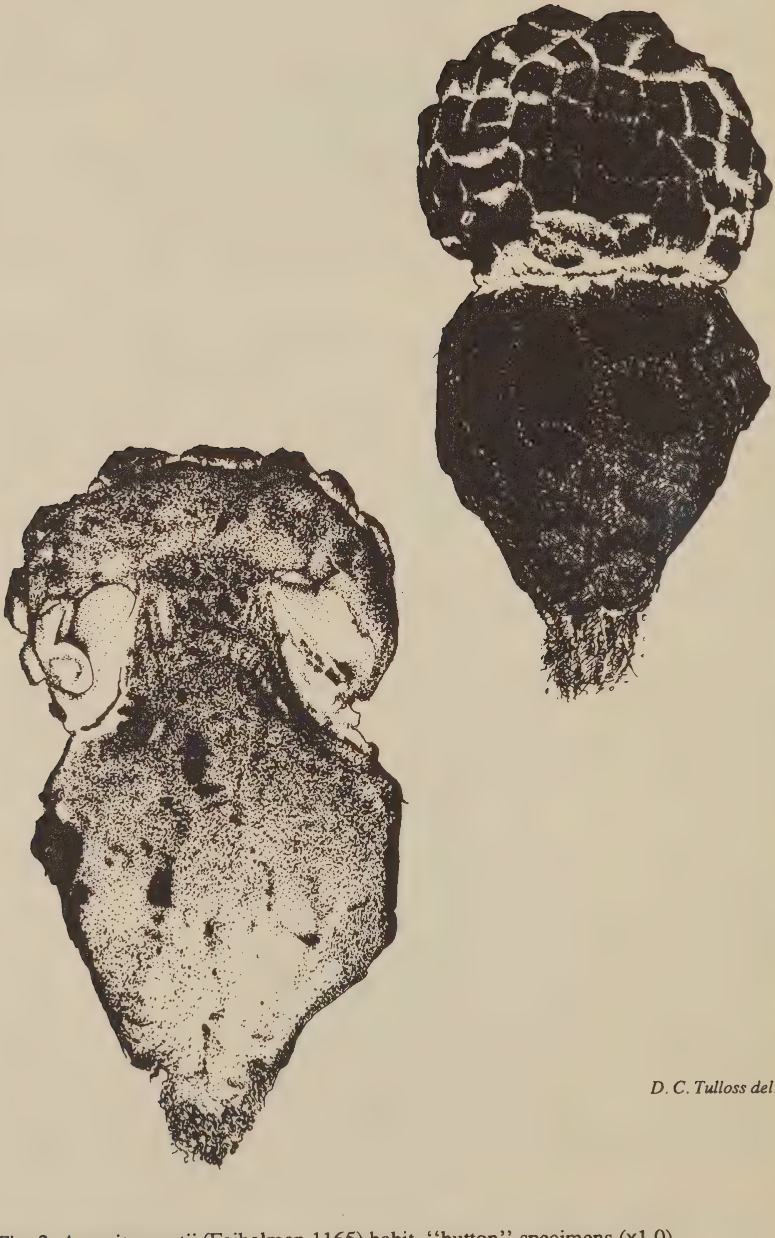

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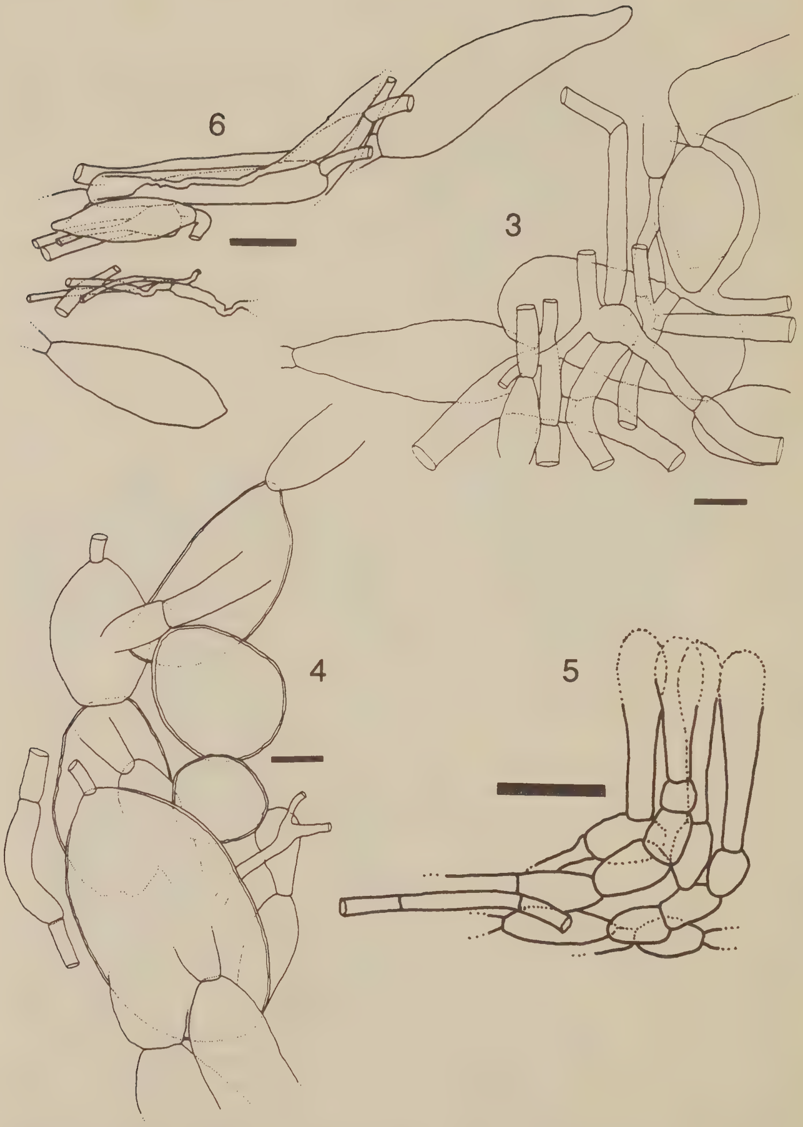
Fig. 2. *Amanita westii* (Feibelman 1165) habit, "button" specimens (x1.0).

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: In mature material: 50 - 65 µm thick, orange-brown in 3% KOH, with surface extensively gelatinized and depigmented; filamentous, undifferentiated hyphae 1.0 - 9.8 µm wide, subradially oriented, tightly interwoven, branching; vascular hyphae 5.0 - 17.5 µm wide, branching, most easily seen in scalp. In "button": 45 - 60 µm thick, ungelatinized, orange-brown to yellow-brown in 3% KOH. PILEUS CONTEXT: cell walls hyaline to yellow-brown to orange-brown in 3% KOH, with those having thickest walls among (but not exclusively) the most strongly pigmented; filamentous, undifferentiated hyphae 2.2 - 9.2 µm wide, branching, often in fascicles, with some intercalary segments inflated up to 15.0 µm wide (cylindric), with walls thin or up to 0.8 µm thick, with septa often constricted; acrophysalides dominating, narrowly fusiform to clavate to broadly clavate to ovoid to ellipsoid, up to 124 x 68 µm, with walls thin or up to 0.8 µm thick; vascular hyphae not observed; clamps not observed. LAMELLA TRAMA: bilateral, with shallow to very shallow angle of divergence, poorly rehydrating in some sections from the holotype, with central stratum 50 - 65 µm wide; filamentous, undifferentiated hyphae 1.8 - 9.2 µm wide, branching, densely interwoven, with some intercalary segments slightly inflated; divergent, terminal, inflated cells not observed; vascular hyphae not observed. SUBHYMENIUM: inflated ramose to ramose, with depth of subhymenial tree 10± µm under longest basidia/-oles and 25± µm under shortest basidioles, comprised of uninflated or partially inflated short hyphal segments (up to about 16 µm long, but most shorter than 13 µm long) in branching structure, sometimes with ovoid to ellipsoid intercalary inflated cells (these larger than most uninflated hyphal segments and concentrated adjacent to central stratum), rather densely interwoven, with basidia arising from both ends and sides of hyphal segments, with some segments parallel to the central stratum immediately below the bases of the longest basidia, with about one to three cells between divergence from central stratum and base of basidium. BASIDIA: 41 - 64 (-70) x (7.2-) 9.0 - 13.2 (-14.0) µm, dominantly 4-, but occasionally 2- or 1-sterigmate, many with yellowish brown to pale yellowish brown contents in side view (orange-brown to red-brown in mass or in end view) in both 3% KOH and 2-3% NH_4OH, sometimes orange-brown to red-brown in Melzer's Reagent; clamps not observed. UNIVERSAL VEIL: *On pileus* (from "button"): elements with vertical orientation except near base, there often with periclinal orientation, frequently hyaline or pale yellow, occasionally orange-brown (but then for only a few consecutive hyphal segments or even only for a portion of one segment), less pigmented than adjacent pileipellis and pileus context; filamentous, undifferentiated hyphae 3.2 - 15.0 (-26) µm wide, branching, with walls thin or slightly thickened, some with pale yellow walls, plentiful to dominating in the base of the wart, otherwise scattered; inflated cells terminal, singly or in chains, broadly fusiform to clavate to ovoid to ellipsoid to subglobose, with the roundest nearest top of wart, dominating above base of wart, up to 112 x 64 µm or larger, with walls usually at least somewhat thickened (up to 0.8 µm thick); vascular hyphae 4.5 - 12.0 µm wide, yellow-brown, absent in most sections, relatively common in one, frequently branching; clamps not observed. *On stipe base*: similar. STIPE CONTEXT: longitudinally acrophysalidic, with cell walls hyaline to brown; filamentous, undifferentiated hyphae 1.5 - 10.5 µm wide, branching, often in fascicles, plentiful, with walls thin or up to 1.0 µm thick, with some intercalary cells having form and size of acrophysalides; acrophysalides plentiful, up to 211 x 51 µm, with walls thin or up to 1.0 µm thick; vas-



Figs. 3-6. *Amanita westii.* 3. Elements from base of universal veil from pileus of "button" (Feibelman 1165). 4. Elements from upper portion of universal veil from pileus of "button" (Feibelman 1165). 5. Elements of hymenium and subhymenium and adjacent central stratum (Feibelman 1165). 6. Elements of partial veil (Lewis 4074). Dark bars indicate 20 µm.

cular hyphae 4.0 - 21 μm wide, branching, yellow-brown, common. PARTIAL VEIL: cells hyaline to yellow-walled to brown-walled; filamentous, undifferentiated hyphae 2.0 - 10.5 μm wide, in tangled and interwoven fascicles, branching, with majority subradially oriented, many collapsed or poorly rehydrating, plentiful to locally dominant, with many terminal segments slightly inflated, with some intercalary segments slightly inflated (cylindric), thin-walled or with walls slightly thickened; inflated cells fusiform to narrowly fusiform to narrowly ellipsoid to subclavate, with narrower forms often subrostrate to rostrate, up to 125 x 32 μm, terminal, singly, with walls thin or up to 0.8 μm thick; vascular hyphae not observed.

BASIDIOSPORES: [100/4/3] (8.5-) 10.2 - 14.0 (-15.5) x (5.8-) 6.0 - 7.8 (-8.2) μm, (**L** = 11.0 - 12.8 μm; **L'** = 12.1 μm; **W** = 6.6 - 7.3 μm; **W'** = 7.0 μm; Q = (1.42-) 1.50 - 1.99 (-2.18); **Q** = 1.67 - 1.79; **Q'** = 1.73), hyaline, smooth, thin-walled, amyloid, ellipsoid to elongate, often adaxially flattened, often slightly swollen at one end, often constricted; apiculus sublateral, small, truncate-conic to cylindric; contents granular, in holotype sometimes yellowish brown in dilute basic solution and turning reddish brown in Melzer's Reagent and then [*per* Bas (1969)] sometimes masking amyloid reaction; color in deposit unknown.

Distribution and habitat: In Florida, subgregarious, under *Quercus* in dry, high hammock (a term peculiar to Florida and indicating usually mesic, climax vegetation——hardwood forest including *Quercus*, *Magnolia*, etc.——often slightly elevated compared to surrounding terrain). In Mississippi, subgregarious in a mesic forest of *Pinus*, *Quercus*, and *Fagus* near a large creek. In Texas, solitary in a xeric forest largely of *Quercus* and *Carya*.

Collections examined: **UNITED STATES**: FLORIDA——Alachua Co. - east of Gainesville, Newmann's Lake, 7.vii.1938 E. West *s.n.* (holotype, FLAS F17466). MISSISSIPPI——Perry Co. - De Soto National Forest, Cypress Creek Landing, 29.vi.1991 Toby Feibelman 1165 (F; L; RET). TEXAS——Newton Co. - Scrapping Valley Timber and Wildlife Research Area, off State Hwy. 87 and Recreational Rd. 255, 1.viii.1987 D. P. Lewis & J. Parigi [Lewis 4074] (F; RET).

DISCUSSION

The large, dark, pyramidal warts and reddish staining reaction of the context make *A. westii* a striking species. It is unique in color and habit among the taxa of *Amanita* described from the Western Hemisphere. The universal veil decorating the pileus often takes on such a strikingly spiky form that, from a distance, one may mistake a specimen of *A. westii* for a bolete belonging in the genus *Strobilomyces* B. Examination of the universal veil on recently collected material (including "button" specimens) supports the likelihood observed by Bas (1969; pers. comm.) that this North American entity has as its closest known phyletic relative *A. sculpta* Corner & Bas (1962) described from North Borneo and Singapore.

Gilbert (1941) suggested *A. westii* was synonymous with *A. flavorubescens* Atk. The latter has a yellow to yellow-brown pileus with yellow, crumb-like warts and belongs to *Amanita* section *Validae* (Fr.) Quél. Reddish bruising or staining reactions in *A. flavorubescens* are usually restricted to context of the lower stipe and basal bulb.

In both 3% KOH and 2-3% NH_4OH, the color of spore contents was not as strong as observed by Bas (1969), but, instead, like the yellow of most refractive cell contents seen in amanitas. The reddish-brown tint of spore contents observed in Melzer's Reagent was visible despite the strong amyloid reaction of the spore wall (observed at 1000x). However, the reddening of contents was never seen to occur so completely or intensely as to mask the amyloid reaction as was noted by Bas. Bas noted scattered brown vascular hyphae in the universal veil warts on the pileus; such hyphae were found in only one of numerous sections of warts from recently collected material.

The stipe context of *A. westii* is curious in that many of the apparent acrophysalides are seen to be intercalary cells with uninflated hyphal segments connected at both their broad and narrow ends.

Tulloss has found (unpub. data) that yellow-walled, septate, filamentous, undifferentiated hyphae are rather common in some taxa of *Amanita* section *Lepidella*. It is possible that some authors have mistaken the pale yellow hyphae for vascular hyphae.

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ORPINOMYCES INTERCALARIS, A NEW SPECIES OF POLYCENTRIC ANAEROBIC RUMEN FUNGUS FROM CATTLE

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ABSTRACT

Orpinomyces intercalaris, a new species of polycentric anaerobic fungus from the rumen of cattle is described and illustrated. The zoospore germinates to produce rhizomycelium which develops mostly intercalary sporangia. The zoospore cyst is persistent and after germination remains as an empty structure attached to the rhizomycelium. It is very distinct during the early developmental stages of the rhizomycelium. Sporangia are globose to subglobose. Zoospores are polyflagellated.

The genus *Orpinomyces* was established by Barr *et al.* (1989) with *Orpinomyces bovis* as the type species. The genus is characterised by polycentric rhizomycelium with terminal or intercalary branched sporangiophore complexes. Zoospores are polyflagellated in contrast to *Anaeromyces*, the only other polycentric genus of Neocallimasticales which has uni- to quadriflagellate zoospores (Breton *et al*, 1990.; Ho *et al.*, 1990; Ho *et al*, 1993a). Only one species (the type species) has been described and assigned to this genus. The type species was originally named *O. bovis* Barr and Kudo (Barr *et al.,* 1989). However, slightly earlier, a polycentric fungus with polyflagellate zoospores was described independently and assigned to the genus *Neocallimastix* as *N. joyonii* Breton *et al.* (1989). The two fungi remained separate taxa until Li *et al.* (1991) studied the zoospore ultrastructure and development of *O. bovis* and concluded that there

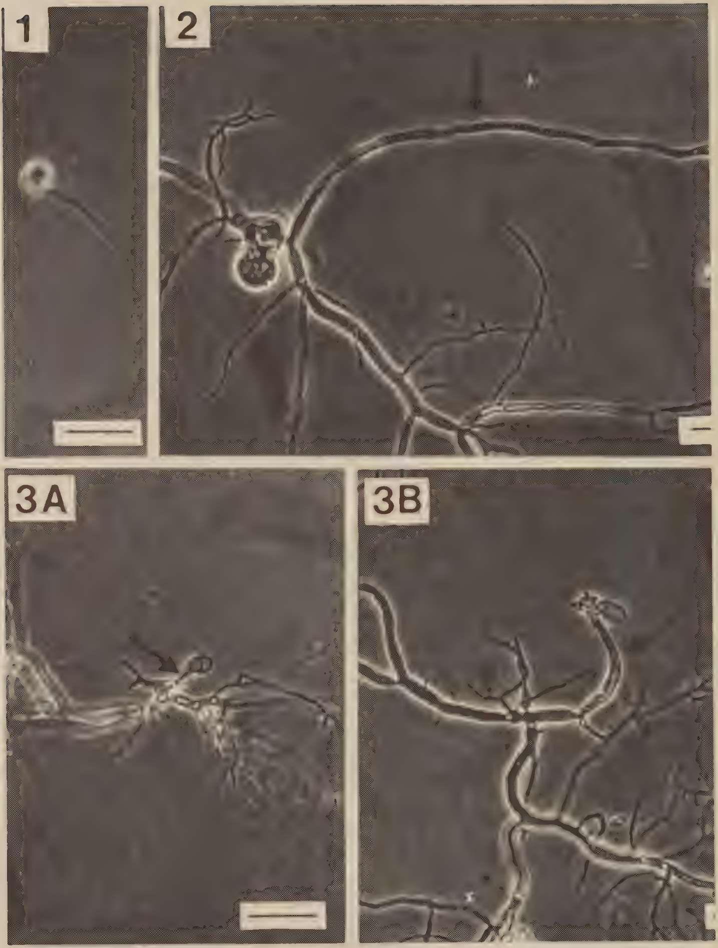


Fig. 1. A polyflagellated zoospore of *O. intercalaris*. Fig. 2. Zoospore cyst with a long unbranched hypha (arrow). Figs. 3A-B. Zoospore cyst with a short unbranched hypha (arrow). Bar = 20 µm.

were not enough of distinctive differences between *O. bovis* and *N. joyonii* to warrant separate genera. They also considered them to be the same species. However, they concurred with *Barr et al.* (1989) that a new genus, *Orpinomyces*, should be erected to accomodate this new polycentric fungus. Since *N. joyonii* has priority over *O. bovis*, they decided to combine the two names and renamed the fungus *Orpinomyces joyonii* (Breton *et al.*) Li *et al.*, comb. nov. (Li *et al.*, 1991).

The fungus described in this paper was isolated from the rumen contents of a cattle (*Bos indicus*) fed guinea grass (*Panicum maximum*) *ad libitum*. The method of isolation was similar to that described by Ho & Bauchop (1991). The media for culturing the fungal isolate were glucose sloppy medium, cellulose sloppy medium and liquid medium with rice straw as carbon source (Ho & Bauchop, 1991). The isolate belongs to the genus *Orpinomyces* but is distinctly different from *O. joyonii.*

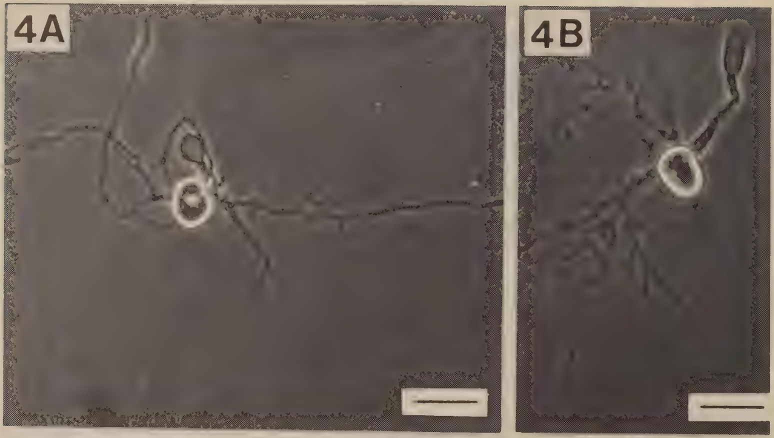
Orpinomyces intercalaris Ho sp. nov. Figs. 1 - 10.

Rhizomycelium complexus, polycentricus et eucarpus. Hyphae multiramosae, plerumque contrictae. Sporangia globosae vel subglobosae subinde irregulares, intercalaria raro terminalibus. Zoosporae globosae, subglobosae, vel forma variabiles, polyflagellatae. Cystae zoosporae persistenti saepe ad rhizomycelium affixus. Specis obligate anaerobia.

Rhizomycelium complex, polycentric and eucarpic. Hyphae much-branched, often with constrictions. Sporangia globose or subglobose, occasionally irregular, intercalary rarely terminal. Zoospore globose, subglobose or variable in shape, polyflagellate. Zoospore cyst persistent, often attached to rhizomycelium. Obligate anaerobe.

From rumen contents of Kedah-Kelantan cattle (*Bos indicus*), Universiti Pertanian Malaysia (UPM). Serdang, Malaysia, 25 March, 1993, Y.W. Ho. Type: Figs. 1-10. A culture, C70, is being maintained at UPM.

The zoospores of *O. intercalaris* are mostly globose, about 8.5-14 μm in diameter, but occassionally subglobose or variable in shape when in motion (Fig. 1). They are polyflagellated with about 12-20 flagella, 33-48 μm long, posteriorly orientated. The flagella are shed readily before encystment and germination. Shed flagella are commonly seen next to the zoospore cyst and they usually possess a



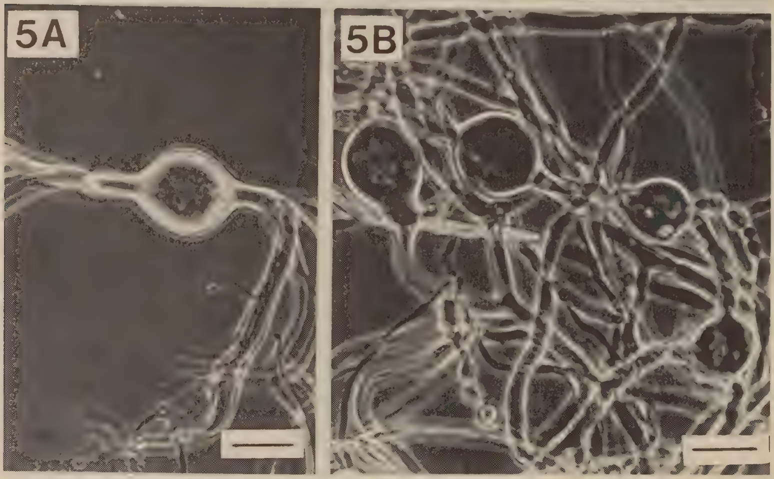


Fig. 4. Initial development of an intercalary sporangium as a small swelling in the hypha of a young rhizomycelium. A, swelling develops near the zoospore cyst. B, swelling develops some distance from the zoospore cyst. Figs. 5A-B. Initial development of intercalary sporangia as swellings in the hyphae in older rhizomycelium. Bar = 20 μm.

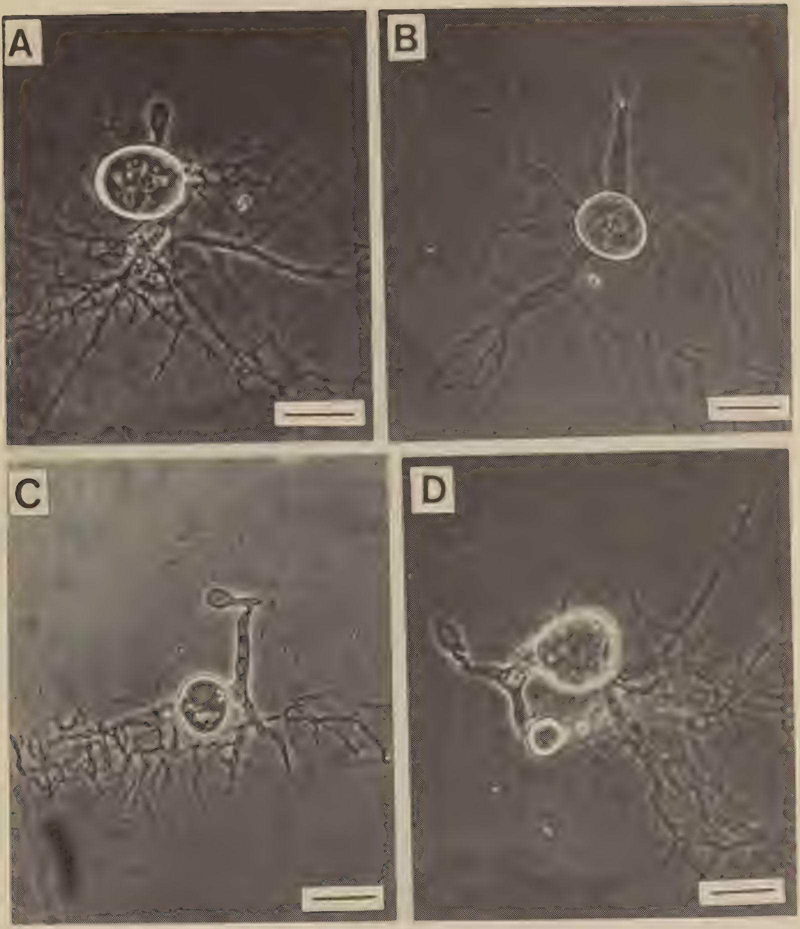


Fig. 6. Intercalary sporangium in a young rhizomycelium. A, sporangium develops near the zoospore cyst. B-C, sporangium develops some distance from the zoospore cyst. D, two sporangia develop some distance from the zoospore cyst. Bar = 20 µm.

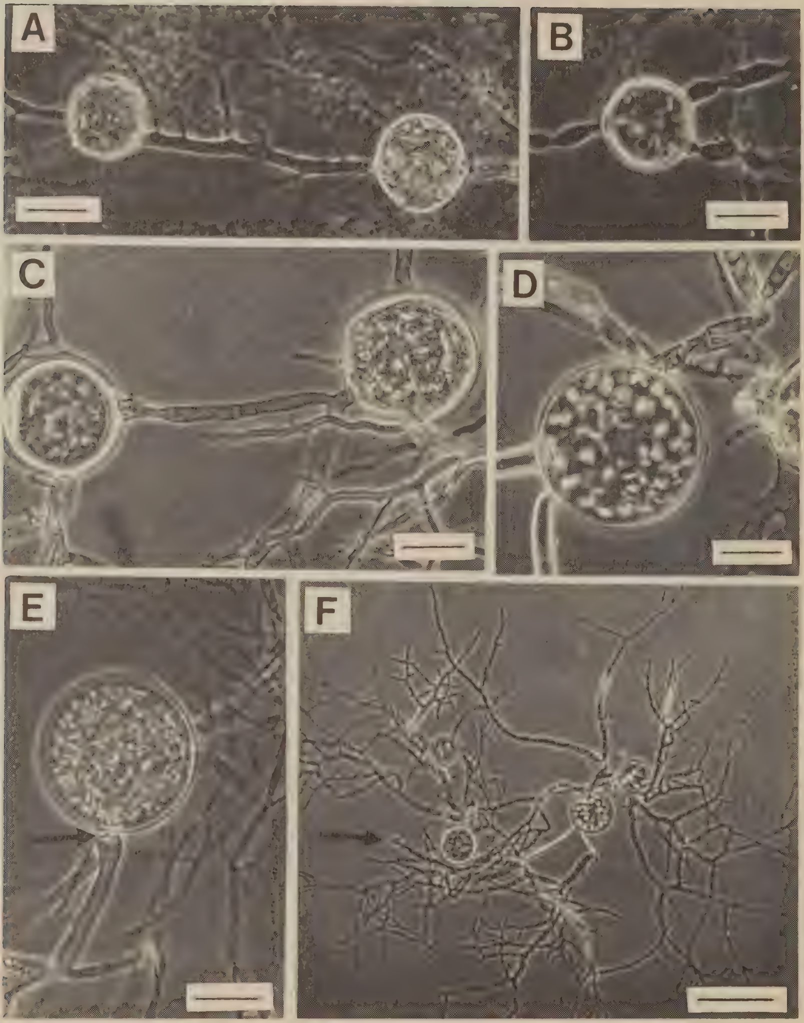


Fig. 7. Intercalary sporangia in older rhizomycelium. A, sporangia develop in one hypha. B, sporangium develops at a hyphal branch. C-D, sporangia develop between a network of hyphae. E, sporangium with a constricted neck (arrow). A-E, Bar = 20 µm. F, a rhizomycelium with intercalary sporangia and a persistent zoospore cyst (arrow) attached to it. Bar = 100 µm.

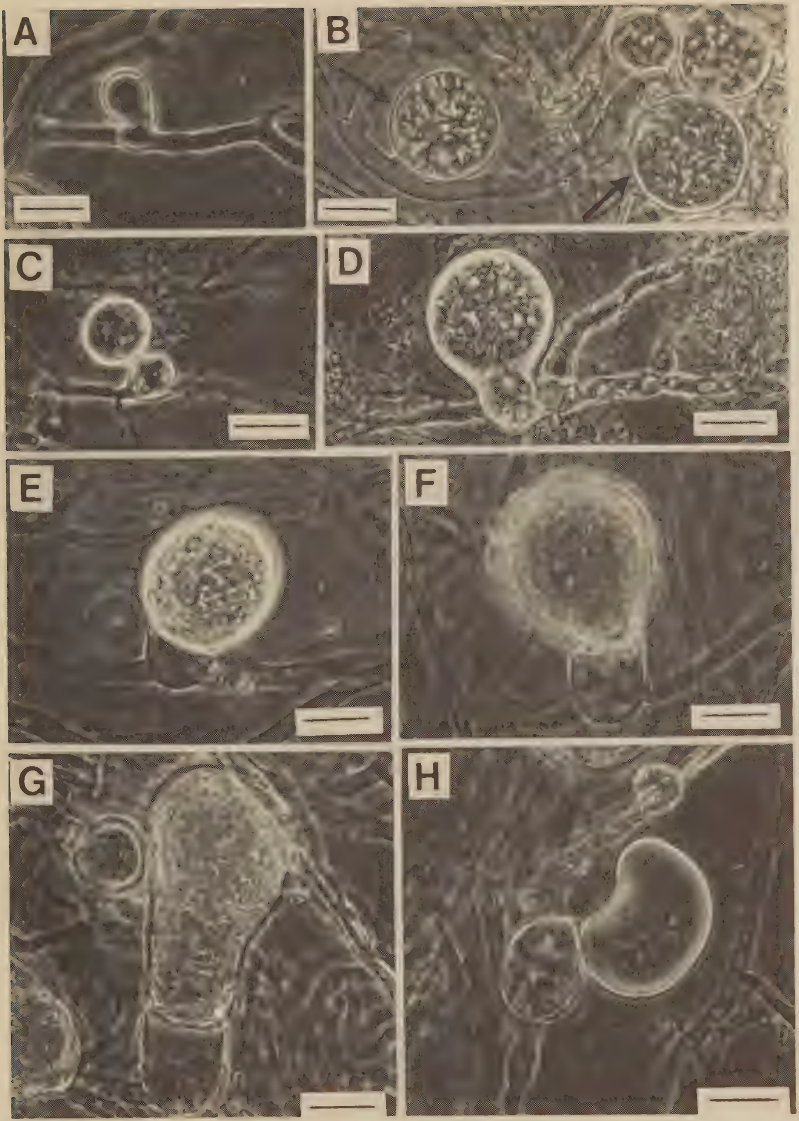


Fig. 8. Development of intercalary sporangium from one side of the hypha. A, a young sessile sporangium develops as a swelling at the side of a hypha. B, mature sessile sporangia (arrows). C, young sporangium with a bulbous basal structure. D, young sporangium with a cup-shaped basal structure. E-F, mature sporangia with basal septum and empty cup-shaped basal structure. G-H, irregularly-shaped sporangium with cup-shaped basal structure. Bar = 20 μm.

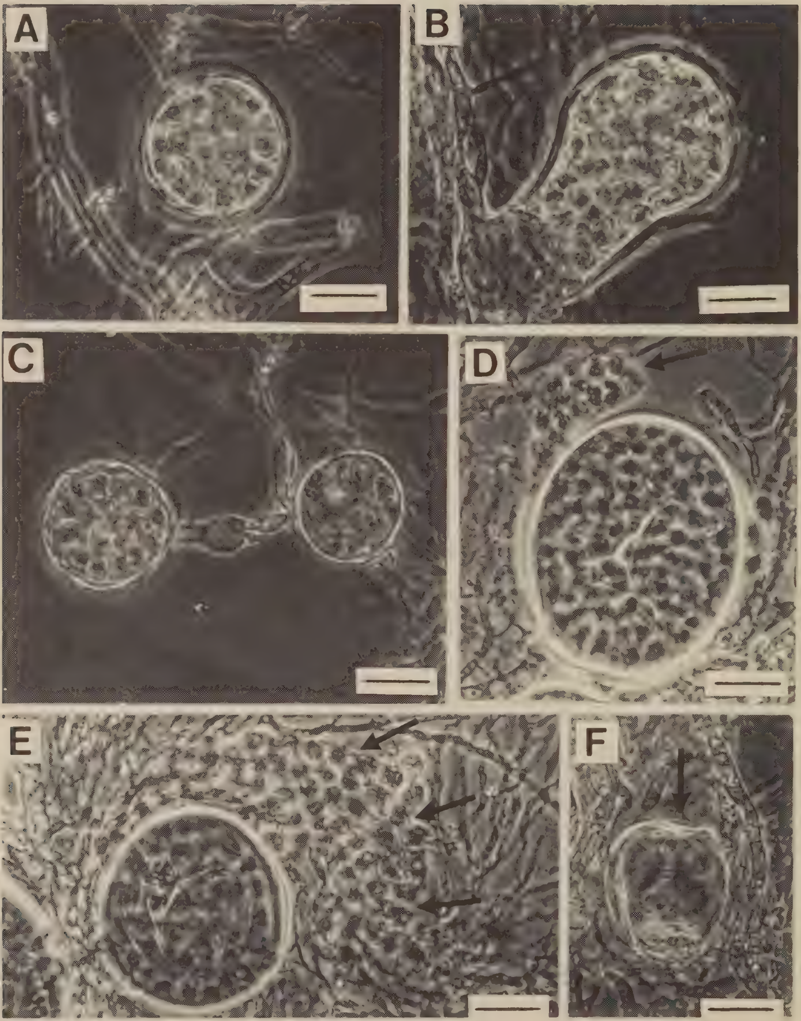


Fig. 9. Zoospore release. A, differentiated zoospores in a globose sporangium. B, differentiated zoospores in an irregularly-shaped sporangium with a cup-shaped basal structure. C, sporangium showing zoospore release. Note the flagella of zoospores emerging through the sporangial wall (arrow). D-E, sporangium with rupture through which the zoospores are released. Arrows show the released zoospores. F, empty sporangium (arrow) after zoospore release. Bar = 20 μm.

bead-like structure similar to that observed in *Neocallimastix* and *Piromyces* species (Barr *et.al.*,1989; Ho *et al.*, 1993b,c,d).

The zoospore germinates by producing a germ tube. The contents of the zoospore are transferred to the germ tube which very quickly expands and elongates to form a hypha. The hypha (3-9 μm diameter) can be unbranched for up to 250 μm long before branching to form a complex rhizomycelium (Fig. 2) or it can branch after a short length (Figs. 3A & B). The empty zoospore cyst (5-9 x 6-20 μm) is persistent and remains as an empty structure attached to the rhizomycelium (Figs. 2-4, 6). It is especially distinct during the early developmental stages of the rhizomycelium.

Sporangia are mostly intercalary, very rarely terminal. They usually develop as a small swelling (Figs. 4-5) in the hypha. The swelling very rapidly expands and becomes separated from the hypha following formation of two septa (Figs. 6C,7A). Sporangia may also develop at points where hypha branch (Figs. 7B-F). The neck (the part between the sporangium and hypha) is either wide (Figs. 7A-D) or constricted (Fig. 7E). During the early developmental stages of the rhizomycelium, sporangia can develop close to the zoospore cyst (Fig. 6A) or at some distance away (Figs. 6B-D). Occasionally, sporangia develop from one side of the hypha instead of from the centre (Figs. 8A-D). Such sporangia can be sessile (Fig. 8B) or have a short bulbous (Fig. 8C) or cup-shaped basal structure (Figs. 8D-F). In a mature sporangium, a basal septum is formed and the cup-shaped structure appears empty (Figs. 8E-G). Sporangia with basal structures are common in older cultures of 3-4 days in all the three media used.

Sporangia are mostly globose to subglobose (Figs. 6-8), occasionally irregular, especially those with basal structures in older cultures (Figs. 8G-H). Sporangium size is variable, ranging from 26-95 μm in diameter. Most of the sporangia are concentrated at the centre of the colony compose of rhizomycelium. There are fewer sporangia at the edge of the colony.

Zoospore release is through rupture of the sporangial wall (Figs. 9A-F). Collapse and dissolution of the sporangial wall take place after zoospore release. Some of the sporangia, particularly the very large ones, are apparently unable to release the zoospores. These sporangia containing the zoospores become brown and moribund. A similar phenomenon has been observed in some *Neocallimastix* species (Barr *et.al.,*1989; Ho *et al.*, 1993b). The thick wall in the larger sporangia probably impede the normal release mechanism of the sporangia (Barr, 1984).

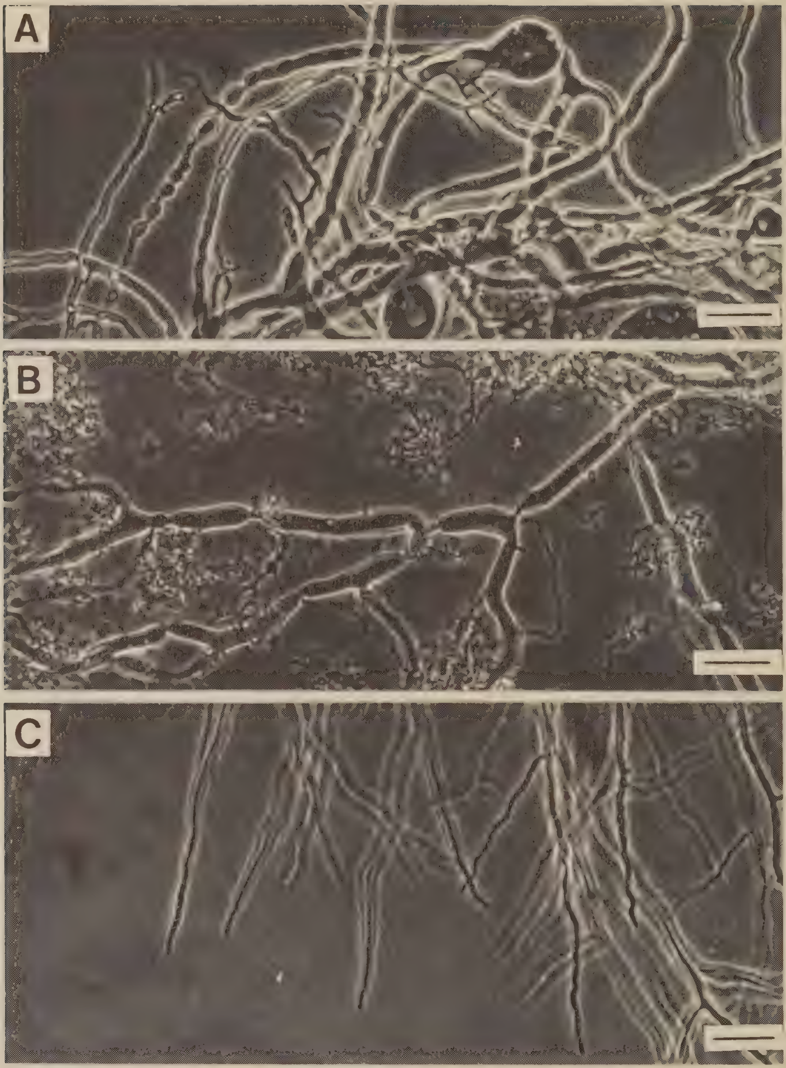


Fig. 10. Rhizomycelium of *O. intercalaris*. A, hypha with a bead-like appearance (arrow) with constrictions at close intervals. B, sausage-shaped hyphae with constrictions at longer distance. C, tips of hyphae with fine to moderately blunt ends. Bar = 20 μm.

In glucose sloppy medium or cellulose sloppy medium, the rhizomycelium grows extensively, forming discrete colonies of 2-4 mm after 2-3 days. The rhizomycelium consists of much-branched, narrow to wide hyphae ranging from 1.5-10.5 µm in diameter. Some of the larger hyphae have tightly constricted points at close intervals giving the hyphae a bead-like appearance (Fig. 10A) or at longer intervals resulting in sausage-shaped hyphae (Fig. 10B). The tips of the hyphae are more or less straight with fine to moderately blunt ends (Fig. 10C). Hyphae with tightly constricted points are very common in polycentric anaerobic rumen fungi. They have been observed in *O. joyonii* (= *O. bovis*, Barr *et al.*, 1989) and *Anaeromyces elegans* Ho (Ho *et.al.*, 1993a) (= *Ruminomyces elegans* Ho, Ho *et al.*, 1990). They have also been observed in some monocentric anaerobic rumen fungi such as *Neocallimastix* sp (Barr *et. al.*, 1989), *N. variabilis* (Ho *et al.*, 1993b) , *Piromyces communis* (Barr *et.al.*, 1989) and *P. minutus* (Ho *et al.*, 1993c).

The presence of predominantly intercalary sporangia, which develop between hyphae and not borne terminally on a sporangiophore, is a distinct feature of *O. intercalaris* that distinguishes it from *O. joyonii*. In *O. joyonii*, the sporangia are all terminal, formed at the apices of sporangiophore complexes. The sporangiophores are terminal or intercalary and they are irregularly branched. The persistent empty zoospore cyst (after germination) which remains as a distinct structure attached to the rhizomycelium is another characteristic feature of *O. intercalaris*.

These distinct characteristics merit *O. intercalaris* to be assigned to a new species.

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THE ORIGINAL COLLECTIONS OF ARTURO NANNIZZI (1877-1961) IN THE HERBARIUM UNIVERSITATIS SENENSIS (SIENA)

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Abstract. the nature, size and actual state of conservation of the original mycological collection of Arturo Nannizzi (1877-1961), eminent Siena mycologist of the Attilio Tassi (1820-1905) school, are herewith illustrated. The complete autoptic material of which Arturo Nannizzi described many new taxonomic units is listed. Such material needs to be typified and this essay shall represent a useful basis for those taxonomists interested in these systematic groups.

Introduction

This paper deals with the description of the micromycetes collections of the *Herbarium Universitatis Senensis* (SIENA). We believe a catalogue of the material concerning the fungi described by Siena mycologists useful for taxonomic study also due to the fact that the specimens, often requested, have been returned with annotations but no precise type designation. Hopefully specialists shall provide a typification of this material and the collections shall be definitely and correctly arranged. Care of the Siena collections has not been at the level of its importance in the past and this has impeded the necessary support to systematic research of value such as SUTTON's (1975; 1977). Increase of the collections' value and improvement of its management have recently been programmed (MARIOTTI & CHIARUCCI, in press) and illustration of the original material to be typified is the first step.

This first contribution examins those taxonomic units described by Arturo Nannizzi (1877-1961). Pupil of Attilio Tassi (1820-1905), he became a prominent mycologist developing an essential role in the study of many mycetes mostly pathogenic to man (GIACOMINI, 1961; FERRI, 1987; RICCI, 1987). Only after his death and publications by GRIFFIN (1960), SZATHMARY (1960), DAWSON & GENTLES (1961) and STOCKDALE (1961), was his merit acknowledged: recognizing the dermatophyte as anamorphs of ascomycetes belonging to the *Gymnoascaceae* family and hence placement in the correct systematic position (NANNIZZI, 1926a). He described a new genus of *Hyphales* (NANNIZZI, 1931) and many other new fungi species of pathological interest to man (for a complete bibliography see GIACOMINI, 1961). He also worked profitably in the field of saprophyte fungi and plant parassites of which he recognized and described many new species.

Arturo Nannizzi's collections in SIENA

The material studied by Siena mycologists of the Tassi school, mostly fungi but also lichens (CHIARUCCI & LOPPI, 1990) were originally gathered by Flaminio Tassi in a collection denominated *Mycotheca Universalis*. This was not only comparison material, holding also in fact specimens originating from the *Erbario Crittogamico Italiano*, but also a collection of the original specimens of taxonomic units described by Tassi. The collection was later incremented by other mycologists with samples from personal research, and with commercial and comparative collections as the already cited *Erbario Crittogamico Italiano*, *Mycotheca Italica* by Saccardo and the *Mycotheca Germanica* by Sidow. Presently the *Mycotheca Universalis* holds 67 volumes of hard carton holders containing sheets on which the specimen envelopes are pinned (MARIOTTI & CHIARUCCI, in press).

Volumes **31-34**, **41** and **43** contain the Nannizzi collection most of which labeled with a reference note: **31**: *Funghi di Taranto* (75 specimens); **32**: *Contributo Fl. Micol. della Bulgaria* (48) e *Ricerche sul Padule di Fucecchio* (48); **33**: *Mycologia Senese* (80) e *Batteriosi della Zinnia elegans* (1); **34**: *Funghi di Taranto, S. Nicolicchio* (59); **41**: *Mycologia Senese* (74); **43**: *Mycologia senese* (45).

Autoptic material

Specimens belonging to the original Nannizzi collection, to be typified, are listed here below. The list is based on the valid publicated names (with eventual spelling corrections according to actual rules of I.C.B.N.). The name, essential for the correct identification of the specimen, is complete of bibliographic protologue quotation and description of the collecting site. It is followed by the label wording of the specimen found in the Herbarium in inverted commas and, in square brackets, by the position (of the volume and sheet) of the specimen itself in the "*Mycotheca Universalis*" (SIENA).

For several reasons (author's handwriting, date, uniqueness of almost all the specimens per species, etc.) we are convinced that the specimens we found are the same ones Nannuzzi described; however, only for a few did he specify that "[...] the material examined is preserved in the Mycotheca of the Botanical Institute of Siena [...]". In addition for some taxonomic units, already validly described in Nannizzi (1926b) and Nannizzi (1927) the author repeats after the diagnosis including an autographed iconography (Nannizzi, 1928a) which could be used for typification according to the art. 9.3 of the I.C.B.N.. The various possibilities of typification hence should be studied.

We believe that the micromycetes should have a detailed designation of the type, clearly showing what corrisponds to the protologue on the autoptic material and including eventual microscope slides and iconographies as the type. The example of *Clathrospora patriniae* Nannizzi (see further ahead) evidences this belief. Many are the cases in which what appears a *holotypus* at first glance, is really a number of elements partly used for the protologue and partly foreign to it. Although difficult and not usual, we think a choice (lectotypification) of that or those sole elements indispensable and sufficient. This choice should not only be stated in revision papers but also clearly indicated on the collection material.

The original material on whose basis Nannizzi (1925b) redescribed the genera *Heterobotrys* Sacc. illegitimately modifying the name to *Morularia* Nannizzi, has unfortunately been lost. According to Meecker (1975) *Heterobotrys paradoxa* Sacc. (= *Morularia saccardiana* Nannizzi) is the anamorph of *Seuratia millardetii* (Raciborski) Meecker.

List of the described taxonomic units:

ASCOMYCOTINA

DOTHIDEALES

Mycosphaerellaceae

Sphaerella agostinii Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 437-438 (1927).

Hab. in foliis vaginisque exsiccatis *Crithmi maritimi* in parva insula S. Nicolicchio prope Tarentum. Sept. 1927 (Nannizzi, 1927, 1928a).

"Sphaerella crithmi sp. n./ Foglie e guaine secche di Crithmum/ maritimum. Isolotto di S. Nicolicchio/ (Taranto) Sett. 1927" (SIENA, [**34**: 18]).

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Note: as known, the genus *Sphaerella* (Fr.) Rabenh. non Sommerf. (Algae) è *nomen gen. illegitt*. and is substituted by *Mycosphaerella* Johanson (1884).

Sphaerella sassafras Ell. & Ev. f. *major* Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 4: 89 (1929).
Hab. in foliis emortuis *Sassafras officinalis* in Horto botanico Senensi, Italiae. Oct. 1928 (Nannizzi, 1929).
"Sphaerella Sassafras Ell. et Ev./ forma major Nannizzi/ Foglie di Sassafras officinale/ Orto bot. Siena/ Ottobre 1928 A. Nannizzi" (SIENA [**33**: 32]).
Note: see previous species.

Pleosporaceae

Clathrospora patriniae Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 3: 960 (1928).
Hab. in foliis petiolisve putrescentibus Patriniae sibiricae in Sibiria australi, M. Karakol, 4 jun. 1923 (Nannizzi, 1928c).
"Clathrospora patriniae Fol. putrescenti di Patrinia sibirica" (SIENA [**41**: 35]).
Note: *Clathrospora* is *nomen gen. rejic.* in favour of *Pleospora*, nevertheless Shoemaker & Babcock (1992) examining the original material of the species described by Nannizzi, form the new combination *Platysporoides patriniae* (Nannizzi) Shoemaker & Babcock. In a recent and accurate paper, these authors identify four different taxonomic units of the original material including two petioles and a small leaf fragment. The characters of two of the taxonomic units were used for the original description; in fact Nannuzzi probably exchanged ascospores of *Pleospora comata* Auerswald & Niessl for mature stages of *Clathrospora* spores. With valid motivations do Shoemaker & Babcock (1992) maintain the specific name limiting it to the taxonomic unit with applanate ascospores.

Leptosphaeria altaica Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 3: 961 (1928).
Hab. in vaginis exsiccatis foliorum *Polygoni Bistortae* in Sibiria australi prope Cemal secus flum. Katum, M. Altai, 20 jun. 1923 (Nannizzi, 1928c).
"Leptosphaeria altaica sp. n./ Guaine secche di Polygonum/ Bistortae" (SIENA [**34**: 9]).
Note: *Leptosphaeria* is *nomen gen. cons.*

Pleospora herbarum (Pers.: Fr.) Rabenh. f. *rosae-banksiae* Nannizzi, Riv. Pat. Veg., 18 (9-10): 190 (1928).
Habitat in foliis vivis Rosae Banksiae in Horto botanico Senensi, Italiae; oct. 1928 (Nannizzi, 1928b).

"Pleospora herbarum Rabh./ f. rosae Banksiae Nannizzi/ Sulle foglie di Rosa Banksia/ Orto bot. di Siena/ 17 ottobre 1928 A. Nannizzi" (SIENA [**33**: 31]).

ERYSIPHALES

Erysiphaceae

Erysiphe polygoni DC. ex Mérat f. *robiniae-hispidae* Nannizzi, Riv. Pat. Veg., 14 (9-10): 173-174 (1924).

Hab. in foliis vivis vel languentibus Robiniae hispidae in horto botanico Senensi, mense octobri 1924. Status conidicus orbiculari sistit (NANNIZZI, 1924).

Note: no specimen found in SIENA. Previously, NANNIZZI (1923) had described the conidic stage of the taxonomic unit denominating it, in a way now illegitimately, *Oidium orbiculare* (= *O. monosporum* Passerini). No sample was found in SIENA, not even under this binomio.

SPHERIALES

Trichosphaeriaceae

Eriosphaeria dumetorum Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 438 (1927).

Hab. in ramulis siccis Rosmarini officinalis in dumetis prope Chiatona, Tarentum. Sept. 1927 (NANNIZZI, 1927, 1928a).

"Eriosphaeria littoralis sp. n./ Rametti di Rosmarinus officinalis/ 7 sett. 27. Chiatona, lungo il mare" (SIENA [**31**: 6]).

Xylariaceae

Anthostomella maritima Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 437 (1927).

Hab. in tunicis siccis bulborum *Urgineae maritimae* in parva insula S. Nicolicchio prope Tarentum. Sept. 1927 (NANNIZZI, 1927, 1928a).

"Anthostomella maritima sp. n./ Tuniche bulbi di/ Urginea maritimae/ S. Nicolicchio/ Taranto/ Sept. 1927" (SIENA [**31**: 1]).

DEUTEROMYCOTINA

COELOMYCETES

Ascochytella vaginarum Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 439 (1927).

Hab. in vaginis exaridis foliorum Pini halepensi, Chiatona, Tarentum. Sept. 1927 (NANNIZZI, 1927, 1928a).

"Diplodina vaginarum/ sp. n./ Guaine foliari di Pinus halepensis/ Chiatona. Sett. 1927" (SIENA [**31**: 5]).

Note: the genus *Aschochytella* Tassi has been erroneously typified in the past as *A. deformis* (Karst.) Died. (CLEMENTS & SHEAR, 1931), species not included among the thirteen species originally described by TASSI (1902). This has already been evidenced by SUTTON (1977).

Camarosporium gnidii Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 441 (1927).
Hab. in ramis emortuis *Daphne Gnidii* in dumetis prope Chiatona, tarentum. Sept. 1927 (NANNIZZI, 1927, 1928a).
"Camarosporium Gnidii sp. n./ Rametti secchi di Daphne Gnidium/ nella macchia di Chiatona. Sett. 1927" (SIENA [**41**: 35]).

Camarosporium obtusum Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 1: 506 (1926).
Hab. in scapis, calycibus bracteisve siccis Statice Limonii var. serotinae in parva insula S. Nicolicchio pr. Tarentum, Italia austr. Aug. 1926 (NANNIZZI, 1926b, 1928a).
"Camarosporium obtusum/ Scapi, calici e brattee di Statice/ Limonium L. var. serotina Rchbg./ Taranto aug. 1926" (SIENA [**34**: 2]).

Camarosporium psammae Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 441 (1927).
Hab. in culmis siccis *Psammae arenariae* in arenosis prope Storranum, Punta S. Vito, Tarentum. Sept. 1927 (NANNIZZI, 1927, 1928a).
"Camarosporium Psammae sp. n./ Culmi secchi di Psamma arenaria/ Chiatona (Taranto) Sett. 1927" (SIENA [**31**: 1]).

Coniothyrium garryae Nannizzi, Arch. Bot. Sist. Fitogeogr. Genet., 8: 298 (1932).
Hab. in ramulis emortuis Garryae Faydeanae in horto botanico Senensi cult. Nov. 1931 (NANNIZZI, 1932).
"Coniothyrium Garriae n. sp./ Rametti secchi di Garrya Faydena/ orto bot. Siena Nov. 1931" (SIENA [**41**: 36]).
Note: species not cited by BIGA *et al.* (1959).

Coniothyrium manihotis Nannizzi, Arch. Bot. Sist. Fitogeogr. Genet., 8: 298 (1932).
Hab. in ramis emortuis Manihotis palmatae in horto botanico Senensi. Nov. 1931 (NANNIZZI, 1932).
"Coniothyrium Manihotis/ n. sp./ rami morti di Manihot palmata/ Ort. bot. Siena Nov. 1931" (SIENA [**41**: 35]).
Note: species not cited by BIGA *et al.* (1959).

Coryneum feijoae Nannizzi, Arch. Bot. Sist. Fitogeogr. Genet., 8: 300 (1932).
Hab. in foliis vivis *Feijoae Sellowianae* in horto botanico Senensi cult. Febr. 1932 (NANNIZZI, 1932).
"Coryneum Feijoae n.sp./ foglie vive di Feijoa Sellowiana/ Orto bot. Siena. Febbr. 1932" (SIENA [**41**: 35]).
Note: SUTTON (1975) supposes that the species be referred to the genus *Seimatosporium* Corda, but precises that not having received the original material from SIENA for accurate examination he doubts the identity of the species described by Nannizzi.

Cryptosporium lunatum Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 442 (1927).
Hab. in ramulis emortuis *Pinus halepensi* in sylvis dumetisque prope Chiatona, Tarentum. Sept. 1927 (NANNIZZI, 1927, 1928a).
"Crysptosporium lunatum sp. n/ (mescolato ad un ascomicete rametti secchi di Pinus halepensis/ Chiatona (Taranto) Sett. 1927" (SIENA [**41**: 36]).
Note: SUTTON (1980) distributes the various species of *Cryptosporium* among different genera, but *C. lunatum* is not cited.

Didymochaeta atropae Nannizzi, Atti R. Acc. Fisiocr. Siena, sez. Agr., 5: 37-38 (1938).
Hab. in caulibus emortuis Atropae Belladonnae in montibus Orlovdol, Bulgariae (NANNIZZI, 1938a).
"Didymochaeta Atropae/ in caulibus emortuis Atropae Belladonnae/ 1936" (SIENA [**53**: 10]).
Note: in SIENA (*Mycotheca Universalis*) vol. **32** (where Bulgaria specimens are preserved), at pag. 26 there is a label indicating: "10/ Didymochaeta atropae Nannizzi n. sp.", but the specimen is missing. A specimen can be found at page 10 of vol. **53** (*Mycologia Senese*), where the material of another research is preserved.

Diplodia dorycnea Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 440 (1927).
Hab. in ramulis emortuis Dorycnii hirsuti in dumetis prope Chiatona, Tarentum. Sept. 1927 (NANNIZZI, 1927, 1928a).
"Diplodia dorycnea n. sp./ Rametti secchi di Dorycnium hirsutum/ Chiatona pr. Taranto Sept. 1927" (SIENA [**31**: 4]).

Diplodia porlieriae Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 5: 387 (1930).

Hab. in ramis emortuis Porlieriae hygrometricae in Horto Botanico Senensi; jul. 1930 (Nannizzi, 1930).
"Diplodia porlieriae Nann./ rametti morti di Porlieria hygrometrica/ Ort. Bot. Siena. Aprile 1930/ (Nannizzi)" (SIENA [**43**: 14]).

Diplodia smilacella Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 440 (1927).
Hab. in foliis putrescentibus *Smilacis asperae* in dumetis prope Chiatona, Tarentum. Sept. 1927 (Nannizzi, 1927, 1928a).
"Diplodia smilacella sp. n./ Fol. putresc. di Smilx aspera/ Chiatona (Taranto) Sett. 1927" (SIENA [**31**: 5]).

Diplodina odontitis Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 439 (1927).
Hab. in caulibus siccis Odontitis luteae in nemoribus prope Chiatona, Tarentum. Sept. 1927 (Nannizzi, 1927, 1928a).
"Diplodinia Odontitidis n. sp./ con associata Didymosphaeria brunneola Niessl./ Macchia di Chiatona su cauli secchi di/ Odontites lutea. Sett. 1927" (SIENA [**31**:5]).

Hendersonia cyperi-aegyptiaci Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 440 (1927).
Hab. in calamis foliisque siccis Cyperi aegyptiaci in dunis maritimis prope Chiatona, Tarentum. Sept. 1927 (Nannizzi, 1927, 1928a).
"Hendersonia arenicola sp. n./ sulle foglie di Cyperus aegyptiacus/ Chiatona (Taranto)/ Sept. 1927" (SIENA [**34**: 9])
"Hendersonia arenicola sp. n./ Scapi di Cyperus aegyptiacus/ sulle arene marittime pr. Chiatona/ (Taranto) Sett. 1927" (SIENA [**31**: 6]).
Note: *Hendersonia* Sacc. 1884 non Berk 1841 is *nomen gen. rejic.* pro *Stagonospora*, but some species have been included in *Hendersonula*. A reliable identity cannot be attributed to the species described by Nannizzi without examination of the original material.

Hendersonia pteleae Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 5: 387 (1930).
Hab. in ramis emortuis Pteleae trifoliatae in Horto Botanico Senensi; oct. 1929 (Nannizzi, 1930).
"Hendersonia pteleae Nann./ Rami morti di Ptelea trifoliata/ Orto bot. di Siena. Ott. 1929/ (Nannizzi)" (SIENA [**43**: 13]).
Note: see previous species.

Macrophoma leptopoda Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 439 (1927).
Hab. in ramis siccis Nicotianae glaucae, S. Nicola prope Punta Rondinella, Tarentum. Aug. 1927 (NANNIZZI, 1927, 1928a).
"Macrophoma Nicotianae sp. n./ Cauli morti di Nicotiana glauca/ S. Nicola, sui muri, Ag. 1927/ (Taranto) (SIENA [**34**: 10]).
Note: *Macrophoma* is *nomen gen. rejic.* pro *Sphaeriopsis* Sacc. *nomen cons.* (SUTTON, 1980).

Pestalotia ventricosa Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 442 (1927).
Hab. in ramulis siccis Lonicera implexae in dumetis prope Chiatona, Tarentum. Sept. 1927 (NANNIZZI, 1927, 1928a).
"Pestalozzia ventricosa n. sp./ Rametti secchi di Lonicera implexa/ associata a Pleospora herbarum/ Chiatona (Taranto) Sett. 1927" (SIENA [**31**: 12]).
Note: there are two schools: one holds a wide concept of the genus (GUBA, 1961) the other subdivides the genus in *Pestalotia, Pestalotiopsis* and *Truncatella* (STEYAERT, 1949, 1953, 1955; SUTTON, 1969). Only the examination of the original material could allow a convincing identification of the species described by Nannizzi.

Phaeoseptoria rubiae Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 441 (1927).
Hab. in foliis vivis Rubiae peregrinae in dumetis prope Chiatona, Tarentum. Sept. 1927 (NANNIZZI, 1927, 1928a).
"Phaeoseptoria Rubiae Nann./ Sulle foglie di Rubia peregrina/ Chiatona (Taranto) Sett. 1927" (SIENA [**34**: 11]).

Phoma debeauxi Roum. f. *scapicola* Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 438 (1927).
Hab. in scapis emortuis Statice Limonii var. serotinae prope S. Annam, Punta S. Vito, Tarentum. Aug. 1927 (NANNIZZI, 1927, 1928a)
"Phoma debeauxi Roum. forma/ Scapicola n.f./ Scapi secchi di Statice Limonium var. se-/ rotina. S. Vito alla Casa dei Bagnanti. Ag. 1927" (SIENA [**32**: 13]).

Phoma fimbriata Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 438 (1927).
Hab. in caulibus emortuis Inulae crithmoidi in parva insula S. Nicolicchio prope Tarentum Sept. 1927 (NANNIZZI, 1927, 1928a)
"Phoma fimbriata sp. n./ Cauli morti di Inula crithmoides/ S. Nicolicchio. Sett. 1927/ (Taranto)" (SIENA [**34**: 12]).

Phoma herbarum Westd. var. *loti-cretici* Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 1: 505 (1927).
Hab. in caulibus emortuis Loci cretici in parva insula "S.Nicolicchio" pr. Tarentum, Italia austr. Aug. 1926 (NANNIZZI, 1926b, 1928a).
"Phoma herbarum/ var. Loti-cretici Nannizzi 1926/ Rametti secchi di Lotus creticus/ Chiatona (Taranto) 7 sett. 1927" (SIENA [**31**: 15]).

Phoma schini-molli Nannizzi, Atti R. Acc. Fisiocr. Siena, Ser. X, 2: 439 (1927).
Hab. in ramulis siccis Schini Molli cult. in horto "Villa Peripato", Tarentum. Sept. 1927. Legit Doct. A. Agostini (NANNIZZI, 1927, 1928a).
"Phoma Schini-Molli sp. n./ Rametti di Schinus Molle/ "Villa Peripato", Taranto. Sept. 1927" (SIENA [**31**: 15]).

Phomopsis phellodendri Nannizzi, Arch. Bot. Sist. Fitogegor. Genet., 8: 297 (1932).
Hab. in ramis emortuis Phellodendri amurensi in horto botanico Senensi cult. Nov. 1931 (NANNIZZI, 1932).
"Phomopsis Phellodendri n. sp./ Rami secchi di Phellodendron amurense/ Orto bot. Siena Nov. 1931" (SIENA [**32**: 13]).

Phyllosticta aberiae Nannizzi, La Vedetta Agricola 2, 14 (1912).
Hab. in foliis vivis Aberiae caffrae in horto botanico Senensi culta, mense novembri 1909 (NANNIZZI, 1912).
"Phyllosticta Aberiae Nannizzi/ Sulle foglie di Aberia caffra/ Orto botanico di Siena/ Aprile 1912 A. Nannizzi" (SIENA [**33**: 29]).

Phyllosticta altaica Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 3: 961 (1928).
Hab. in foliis vivis Veronicae incanae in Sibiria australi secus flum. Matun, M. Altai, 24 jun. 1923 (NANNIZZI, 1928c).
"Septoria altaica n. sp./ Foglie vive di Veronica incana/ Siberia (M. Altai) (SIENA [**34**: 17]).
Note: Only one leaf of *Veronica*, very small and with very rare pustules, makes up the specimen. The corrispondence of the specimen to *Phyllosticta* (*Phoma* s.l.) or *Septoria* has not been controlled to avoid its destruction; however, due to the considerable differences between two genera, this identification would be useful.

Phyllosticta helwingiae Nannizzi 1930, Atti R. Acc. Fisiocr. Siena, ser. X, 4: 91 (1929).

Hab. in foliis vivis Helwingiae rusciflorae in Horto botanico Senensi, Italiae. Sept. 1927 et 1928 (NANNIZZI, 1929).
"Phyllosticta Helwingiae Nannizzi/ Sulle foglie di Helwingia ruscifolia/ Orto botanico di Siena/ Settembre 1928 A. Nannizzi" (SIENA [**33**: 30]).
Note: two specimens.

Phyllosticta ibotae Nannizzi Atti R. Acc. Fisiocr. Siena, ser. X, 2: 438 (1927).
Hab. in foliis vivis Ligustri Ibotae cult. in horto prope Tarentum. Aug. 1927 (NANNIZZI, 1927, 1928a).
"Phyllosticta Ibotae n. sp./ Agosto 1927 Taranto/ Ligustrum Ibota/ Siebl. et Zucc./ (var. Regelianum e Obovatum)" (SIENA [**31**: 14]).

Phyllostictella draconis Nannizzi, Arch. Bot. Sist. Fitogegr. Genet., 8: 297 (1932).
Hab. in foliis vivis Dracaena Draconis in horto botanico Senensi cult. Oct. 1930 (NANNIZZI, 1932).
"Phyllostictella Dracaenae/ n. sp./ Sulle foglie vive di Dracaena Draco/ Orto bot. Siena Ott. 1930" (SIENA [**34**: 11]).
Note: according to SUTTON (1977) the genus *Phyllostictella* Tassi (1901) should probably be considered synonymous of *Microsphaeropsis* Moehn (1917).

Rhabdospora rubiae Pat. var. *amerospora* Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 441 (1927).
Hab. in foliis siccis Rubiae peregrinae in dumetis prope Chiatona, Tarentum. Sept. 1927 (NANNIZZI, 1927, 1928a).
"Rhabdospora rubiae Pat./ var. amerospora n. var./ Foglie secche di Rubia peregrina/ Macchia di Chiatona. Sett. 1927/ (Taranto)" (SIENA [**34**: 17]).

Robillarda aquatica Nannizzi, Boll. Pesca Piscic. Idrobiol., 14: 807 (1938).
Hab. in foliis putrescentibus natantibus Lemnae minoris in padule Fucecchio, Florentiae; 15 mart. 1932 (NANNIZZI, 1938b).
"Robillarda aquatica n. sp./ Foglie putrescenti di Lemna minor/ Padule di Fucecchio/ 15-II-32" (SIENA [**32**: 55]).
Note: according to SUTTON (1980) *Robillarda* Cast. (1845) should be rejected in favour of *Pestalotiopsis* Stey (1949); while for the ICBN (GREUTER, 1988), *Robillarda* Sacc. is nomen gen. conserv.

Septoria asteris-alpinis Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 3: 961 (1928).

Hab. in foliis siccis Asteris alpini in Sibiria australi prope Cemal, secus flum. Katun, M. Altai, 9 jun. 1923 (Nannizzi, 1928c).
"Septoria Asteris-alpini sp. n./ Foglie secche di Aster alpinus" (SIENA [**34**: 17]).

Septoria iridis-japonicae Nannizzi, Arch. Bot. Sist. Fitogeogr. Genet., 8: 299 (1932).
Hab. in foliis vivis Iridis japonicae in horto botanico Senensi cult. Apr. 1931 et 1932 (Nannizzi, 1932).
"Septoria Iridis-japonicae/ n. sp./ Sulle foglie vive di Iris japonica/ Ort. bot. Siena/ apr. 1932" (SIENA [**34**: 18]).

Septoria moesiaca Nannizzi, Atti R. Acc. Fisiocr. Siena, sez. Agr., 5: 38 (1938).
Hab. in foliis Atropae Belladonnae in montibus Buzludgia, Bulgariae (Nannizzi, 1938a).
Note: missing specimen. At pag. 21 of vol. **32** of the *Mycotheca Universalis*, an only sheet reports "Septoria moesiaca Nannizzi n. sp./ 21". The specimen was probably lent and never returned.

Septoria oligocarpa Nannizzi, Riv. Pat. Veg., 15: 3 (1925)
Hab. in foliis vivis Cobeae scandentis in horto botanico Senensi culta, mense decembri 1924 (Nannizzi, 1925a).
Note: no specimen found.

Septoria pachypleuri Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 3: 962 (1928).
Hab. in foliis siccis vel languescentibus Pachypleuri alpini in Sibiria australi, M. Karakol, 17 jun. 1923 (Nannizzi, 1928c).
"Septoria Pachypleuri et/ Sphaerella Pachypleuri Fuck. in/ Heuglin Reisen Nordpol., Vol. III, et/ Oud. Contr. Fl. Myc. Now. Seml. p. 6,/ t. II. f. 2 - Sacc. Syll. IX. p. 624/ Foglie secche di Pachypleurum alpinum" (SIENA [**34**: 18]).

Stagonospora schoeni Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 2: 440 (1927).
Hab. in calamis emortuis Schoeni nigricans in arvis arenosis pr. "Salina Piccola", Tarentum Aug. 1927 (Nannizzi, 1927, 1928a).
"Stagonospora Schoeni sp. n./ Calami morti di Schorenus nigricans/ campi arenosi alla Punta S. Vito, Taranto/ (mescolato con altri micromiceti) Ag. 1927 (SIENA [**31**: 25]).

Torula altaica Nannizzi, Atti R. Acc. Fisiocr. Siena, ser. X, 3: 962 (1928).
Hab. in petiolis putrescentibus foliorum Saxifragae crassifoliae in Sibiria australi, M. Karakol, 17 jun. 1923 (Nannizzi, 1928c)
"Torula altaica sp. n./ Picciuoli fogliari di Saxifraga/ crassifolia" (SIENA [**34**: 21]).

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Hab. in foliis emortuis Phoenicis reclinatae cult in horto "Villa Peripato", Tarentum. Aug. 1927 (Nannizzi, 1927, 1928a).
"Macrosporium Phoenicis n. sp./ Foglie secche di Phoenix reclinata/ Villa Peripato, Taranto 1927" (SIENA [**31**: 10]).
Note: according to Hughes (1958) *Macrosporium* Fr. (1832) non Fr. (1825) should be synonymous of *Alternaria* Nees (1816/1817). This was confirmed by Ellis (1971).

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Hab. in foliis vivis Anonae sp. in Horto botanico Senensi, Italiae; Aug. 1928 (Nannizzi, 1929).
"Cladosporium Anonae Nannizzi/ Sulle foglie di Anona sp./ Orto Botanico di Siena/ Agosto 1928 A. Nannizzi" (SIENA [**33**: 27]).

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LAMBERTELLINIA SCUTULOIDES (SCLEROTINIACEAE), A NEW GENUS AND SPECIES FOR A DISCOMYCETE PREVIOUSLY CONFUSED WITH HYMENOSCYPHUS CAUDATUS

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Abstract

A phaeosporous member of the Sclerotiniaceae, a new genus and species, *Lambertellinia scutuloides* Korf & Lizoň, with a substratal stroma and an *Idriella* anamorph, is described.

KEYWORDS: Sclerotiniaceae, *Lambertellinia*, *L. scutuloides*, Leotiaceae, *Hymenoscyphus caudatus*, *Idriella*.

During a survey of the genus *Hymenoscyphus* an unidentified collection of a helotioid Discomycete from Japan was studied. It has some similarities in spore shape and size to *Hymenoscyphus caudatus* (P. Karst.) Dennis. Another collection, which we treat as conspecific with the Japanese collection, was published under that name by Kimbrough & Atkinson (1972). The Japanese collection is distinguished from the members of *Hymenoscyphus*, as understood by us (Lizoň, 1992), in having light brown spores and a different construction of the excipular structures, and in producing a substratal stroma. We propose it here as a new species and a new genus in the family Sclerotiniaceae.

Lambertellinia scutuloides Korf & Lizoň, gen. & sp. n.

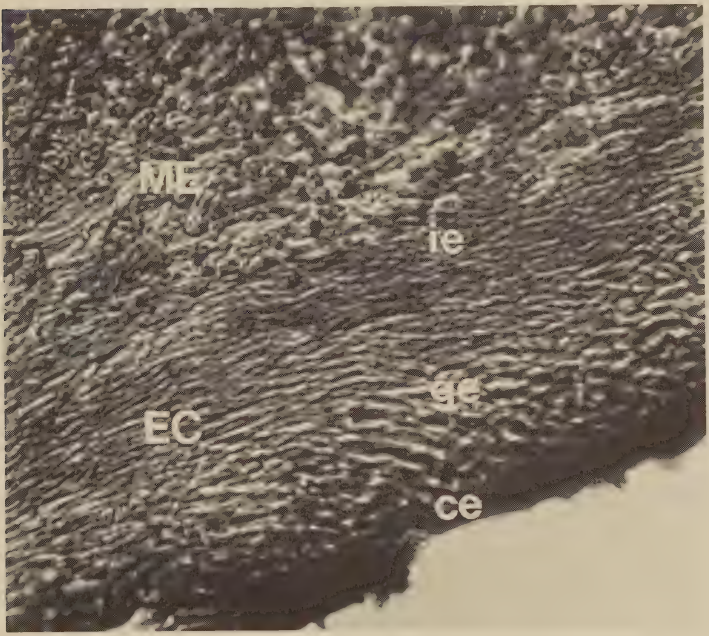
= [*Helotium berberidis* Sydow, Mycoth. March. no. 1576, 1887 (nom. nud.).]

Misappl.: *Hymenoscyphus caudatus* (P. Karst.) Dennis sensu Kimbrough & Atkinson, Amer. J. Bot. 59:165–171, 1972; sensu Dennis, Mycol. Pap. 62:82, 1956, *pro parte*.

> *Apothecia stipitata, lutea, solitaria, stromatis substratalibus. Discus plano-concavus, luteus vel aurantiacus. Receptaculum cupulare, stramineum vel aureum, ad 3.5 mm diam. Stipes concolor, basi brunnescens, 1–4 mm longus et 0.2–1 mm crassus. Excipulum ectale exterius ex textura porrecta bene evoluta formatum (5–20 µm latum), hyphis stramineis vel aureis, 0.5 – 1.5 µm diam., excipulum ectale interius ex textura porrecta vel oblita formatum (ca. 15 µm latum) hyphis flavidis, stratum intermedium (35–55 µm latum) ex hyphis hyalinis et refractivis, 3–6.5 µm diam., muris gelatinosis formatum. Excipulum medullare ex textura porrecta vel intricata formatum (ca. 20 µm latum), hyphis parallelis vel intertextis, 1.5 µm diam. Asci cylindrico-clavati, octospori, (82–) 84.5–100 (–116) x (5.6–) 6.6.–7.5 (–8.3) µm, poro in Melzero caerulescente, non ex uncis orientes. Paraphyses filiformes, 1.5 µm diam. et ascos non transeuntes. Ascosporae oblique biseriatae, clavatae ("scutuloideae") vel inaequilaterales, laeves, primum hyalinae et non-septatae, demum intra ascum pigmentum manifestantes, brunneae vel hyalinae, saepe 1-septatae, (13.8–) 15.4–16.9 (–18.5) x (2.3–) 3.1–3.5 (–3.8) µm. Holotypus: CUP-JA 2252.*

Apothecia yellow, long-stipitate, arising from a black substratal stroma, scattered. Receptacle deep cupulate, with a sharp margin, pale yellow to golden yellow (to brownish), slightly furrowed towards the stipe, up to 3 mm diam. Disc concave to plane, darker yellow than the outer surface to orange-yellow. Stipe cylindric, pale yellow to golden-yellow (to brownish), sometimes brownish towards the base, mainly longer than the diameter of the receptacle, 1–4 x 0.2–1 mm, usually with a black ring of stromatal tissue in the flesh of the base.

Ectal excipulum of 2–3 layers of textura porrecta. Outermost covering layer (5.0–20 µm wide) of parallel, straw- or golden-yellow pigmented hyphae 0.5–1.5 µm diam., outer ectal excipulum (35–55 µm wide) of parallel hyphae 3.0–6.5 µm, hyaline with glassy gelatinized walls, inner ectal excipular cells light yellow with more visible walls (layer about 15 µm wide). **Medullary excipulum** of textura porrecta to textura intricata, forming a layer about 20 µm wide on the flanks,



Lambertellinia scutuloides, an apothecial section of holotype specimen at CUP: **M E** – medullary excipulum, **EC** – medullary excipulum, **ie** – inner layer of ectal excipulum, **ge** – gelatinous layer of ectal excipulum, **ce** – covering layer of ectal excipulum.

composed of parallel or slightly interwoven hyaline hyphae 1.5 µm diam. **Asci** cylindric-clavate, conical at the apex, (82–) 84.5–100 (–116) x (5.6–) 6.6–7.5 (–8.3) µm, pore weakly blue in Melzer's reagent, not arising from croziers. **Paraphyses** filiform, 1.5 µm diam., not extending beyond the asci. **Ascospores** biseriate or irregularly uniseriate, clavate to inequilateral, "scutuloid"[1] hyaline and non–septate when young, light brown or hyaline and occasionally 1-septate when mature and when discharged, with 1–4 (–5) guttules when inasci, but usually eguttulate when discharged, smooth, (13.8–) 15.4– 16.9 (–18.5) x (2.3–) 3.1–3.5 (–3.8) µm. **Stroma** substratal, well developed, rind-like, covering nearly the whole surface of petioles, evident as a superficial blackening of the substrate, in transverse section as a blackened zone surrounding the epidermal cells, in facial view as blackish intercellular lines.

HOLOTYPE: Japan: Honshu, Tsugawa, Ogunimachi, Yamagata Pref., 500–800 m, On *Aesculus turbinata*, 28.VIII.1961, D. Shimizu (CUP–JA 2252).

ETYMOLOGY: *Lambertellinia* refers to the relationship to *Lambertella*, and *scutuloides* refers to the shape of ascospores, similar in shape to those of *Hymenoscyphus caudatus* and *H. scutulus*.

SUBSTRATA: Petioles of *Acer*, *Aesculus*, and *Berberis*.

SPECIMENS EXAMINED: JAPAN: Honshu, Tsugawa, Ogunimachi, Yamagata Pref., 500 – 800 m, On *Aesculus turbinata*, 28.VIII.1961, D. Shimizu (holotype of *Lambertellinia scutuloides*, CUP–JA 2252). [GERMANY], Auf *Berberis vulgaris*, Hippodrom bei Berlin, VIII.1887, P. Sydow (Sydow, Mycoth. March. no. 1576, 1887: FH, NY, "syntypes" of *Helotium berberidis* Syd.).

A culture derived from a collection of a discomycete on leaves of *Acer rubrum*, identified by Kimbrough & Atkinson (1972) as *Hymenoscyphus caudatus*, produced an *Idriella* anamorph. It is clearly different from *Hymenoscyphus caudatus*. The original specimen is not available but according to the description ascospores developed 1–2 septa before germination, and a brown coloration. Both these characters exclude it from *Hymenoscyphus* in the current sense. Based on the description and excellent illustrations of the characters of the excipulum, spores and asci we believe their collection belongs to *Lambertellinia scutuloides*. Kimbrough and Atkinson's misinterpretation of *H. caudatus* was followed by Hennebert & Bellemère (1979), Kendrick & DiCosmo (1979), von Arx (1981), Rappaz (1992), and Rodrigues & Samuels (1992).

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[1] The term "scutuloid" was introduced by Baral (Baral & Krieglsteiner, 1985) for clavate spores in the genus *Hymenoscyphus* with the apex rounded and often slightly hooked to one side, and the base pointed.

Sydow has issued in his Mycotheca Marchica *Helotium berberidis* Syd. (no. 1576, 1887), but no description was provided on the exsiccati label. This species has apparently never been described. The collection has apothecia dark brown (nearly blackish) when dry, brownish when rehydrated, outer surface yellowish, stipe yellow, thin, about half as long as the diameter of the receptacle. Apothecia arise from stromatized veins and petioles of leaves. The ectal excipulum is of textura porrecta, including a layer of hyphae with gelatinized walls. Asci are clavate, conical at the apex, pore weakly blue in Melzer's reagent. Paraphyses are filiform, not exceeding the ascus tips, 2,2 µm diam. Ascospores are biseriate, cylindric clavate, "scutuloid", deep brown to hyaline, non-septate, 16.2 x 4.5, 16.8 x 4.8, 17.1 x 4.5, 17.4 x 4.2, 18.0 x 4.8, 19.8 x 3.6 µm. [all data derived from dry material]. These characters clearly show that this collection ("species") is conspecific with *Lambertellinia scutuloides* as described here, since the difference in apothecial color when dry may represent only the conditions under which they were dried, and the age of the specimens.

Dennis (1956) examined specimens of *Helotium berberidis* in Sydow's Mycotheca Marchica and noted that it "is H. caudatum but is apparently a nomen nudum." He overlooked the brown coloration of spores. We have searched for a description of this species but we have found only a note on the publication of this exsiccatum (Bot. Zeitung 46:204, 1888). A "syntype" specimen at FH has several well developed apothecia, while the "syntype" at NY consists mostly of broken leaves bearing no apothecia.

TAXONOMIC POSITION OF LAMBERTELLINIA

Though there are some genera of the Leotiaceae which produce brown ascospores, or tardily brown ascospores, none of these (*Phaeohelotium, Bulgaria, Bulgariella, Sorokina, Polydiscidium, Velutarina, Pestalopezia, Trochila, Catinella,* among others) has an excipular structure at all recalling that of *Lambertellinia*, and all lack a substratal stroma. The stroma is the clearest indication that we are dealing here with a member of the Sclerotiniaceae. Substratal stromata occur in many genera of the Sclerotiniaceae, and normally are an indication that infection of the substrate has occurred while it was still living. Among the genera with brown or brownish ascospores and a substratal stroma are currently only *Lambertella* and *Phaeociboria* (if that is considered distinct, synonymized by Dumont, 1971). The new genus differs markedly from species of *Lambertella* in the long-celled structure of the ectal excipulum and, in particular, in the production of an *Idriella* anamorph (no species of *Lambertella* is known to produce a conidial anamorph).

There are species in the *Hymenoscyphus subserotinus* "group," mostly tropical, which may prove to be more closely related to *Lambertellinia scutuloides* than to other members of *Hymenoscyphus*. Like *Lambertellinia*, they display a more or less strongly gelatinized or glassy, long-celled excipular structure, and ascospores that are frequently scutuloid (though not regularly turning brown), and there is some evidence of a substratal (but limited) stroma. None have been shown to produce a conidial anamorph. They appear to represent an interface between Leotiaceae (Hymenoscyphoideae) and Sclerotiniaceae. One species in this group, *Lanzia serotina* (Pers. : Fr.) Korf & Zhuang, has recently been shown to produce an extensive stroma in culture but no conidial anamorph (Zhuang, 1993).

Equally puzzling are two species of *Crocicreas* (or of *Cyathicula* if that is considered distinct from *Crocicreas* as suggested by Baral & Krieglsteiner, 1985) collected by the senior author in Macaronesia. Pure cultures of these two collections produce a substratal stroma in some, but not all, culture media. It seems probable that other members of cyathiculoid fungi may also represent an interface between Sclerotiniaceae and Leotiaceae. For example, *Cyathicula hyalina* Beaton has been transferred to *Poculum* (or, more correctly, to *Rutstroemia*) on the basis of the presence of a well-developed substratal stroma. Unlike typical *Rutstroemia* spp., however, this has spores brown at maturity, according to Carpenter (1981). The senior author has unpublished data on European collections of a common *Rutstroemia* species that also develops brown pigmentation on spore germination.

In addition, many (mainly tropical) species placed in such genera as *Hymenoscyphus* and *Cyathicula* are simply insufficiently investigated to determine whether a substratal stroma is produced. For most, no cultures exist to prove the point, or to demonstrate the presence of a conidial anamorph.

Acknowledgments

We wish to thank Dr. Linda Kohn (University of Toronto) for reviewing this paper and Dr. William J. Dress (Cornell University) for the revision of the Latin diagnosis. This research was supported by Anna E. Jenkins bequest in a form of a postdoctoral fellowship to the junior author.

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MYCOTAXON

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AGARICALES OF BAJA CALIFORNIA - MEXICO

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Abstract

A preliminary agaric checklist covering all the species collected is presented. Four of them: *Clitocybe pinophila, Omphalina rosella, Lactarius argillaceifolius var. megacarpus* and *L. alnicola* are fully described and discussed.

Key words: *Fungi, Basidiomycotina, Agaricales, Russulales, Clitocybe, Omphalina, Lactarius, Clitocybe pinophila, Omphalina rosella, Lactarius alnicola, L. argillaceifolius var. megacarpus.*

Introduction

A large number of fresh fruiting bodies of Agaricales were collected and identified during a brief stay in Baja California - Ensenada - Mexico. Of the 23 species listed 4, considered to be especially interesting, were described in detail. The state of Baja California has an amazing floral diversity due to a wide range of habitats, going from sand dunes to oak woods up to the pine forests at 1600 m above sea level. The climate is rather similar to that typical of the Mediterranean area, with very hot summers and relatively cool winters. Prior to our stay the rainfall in the single month of January had been exceptional, this circumstances affected badly our expedition to Sierra Juarez.

Materials and Methods

Microscopic examination, measurements and drawings were made using a Bausch & Lomb and an Olympus BH2 microscopes, equipped with planapochromatic lens and drawing tubes. Freehand sections were mounted in 2% KOH and stained in Melzer's reagent and/or congo red. The material studied is deposited partly in the herbarium of UABC-Ensenada-Mexico and partly in the herbarium of the first author.

Taxonomy

Bolbitius vitellinus (Pers.: Fr.)Fr. **var. fragilis** (L.: Fr.), Ep. Syst. Myc.: 254, 1838.

PLAYA HERMOSA - ENSENADA-B.C.: **12-02-93** leg. et det.: M.C.
Habitat : on sandy soil between the sea and a lagoon. Exs. N° 93021204.

Clitocybe fragrans (With.: Fr.) Kummer, Der Führer in die Pilzk.: 121, 1871.
PLAYA HERMOSA - ENSENADA-B.C.: **12-02-93** leg. et det.: M.C.
Habitat : on sandy soil between the sea and a lagoon. Exs. N° 93021205.

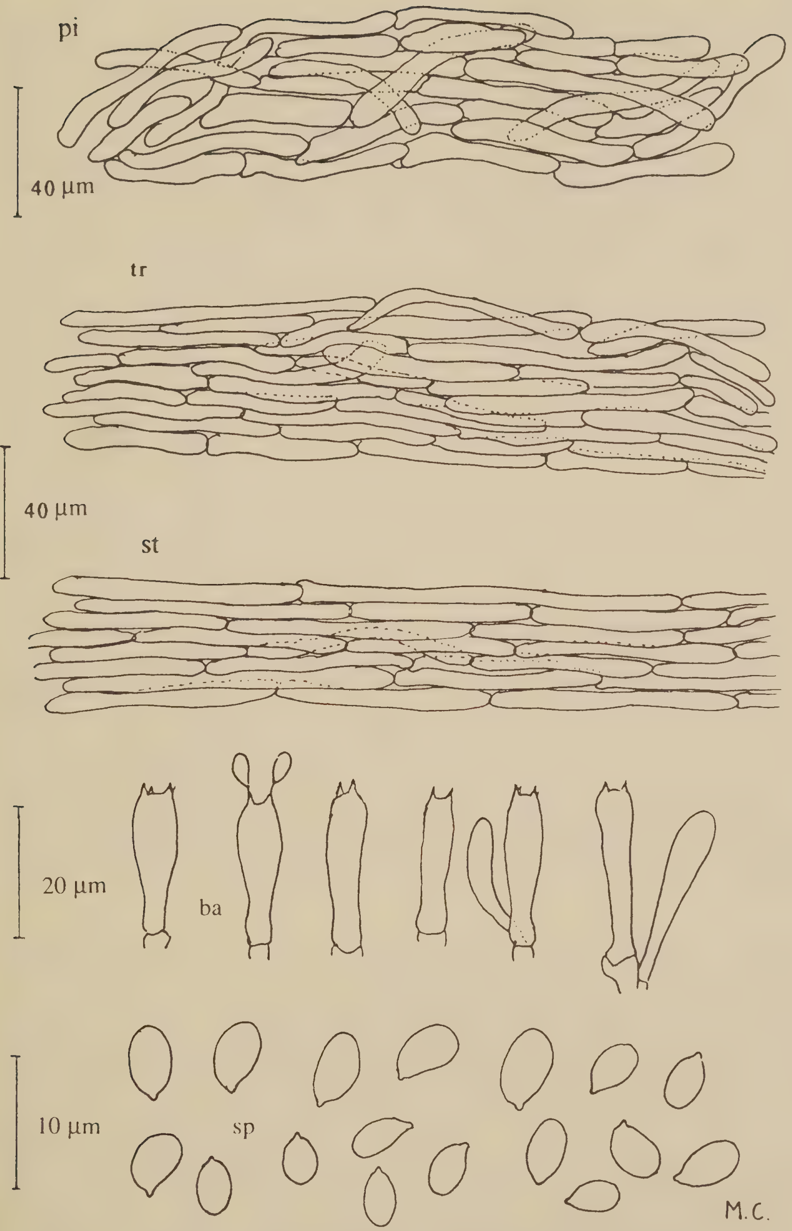
Clitocybe pinophila (Peck) Saccardo, Syll. Fung. V: 183, 1887.
Agaricus (Clitocybe) pinophilus Peck, Rep. New York State Mus. 31: 32, 1879.

ASERRADERO-RANCHO LAS BOTELLAS SIERRA JUAREZ: **17-02-93** leg.: C. Sigüenza Lopez, det.: M.C.
Habitat : on needles of *Pinus jeffreyi*, granitic soil, elev. approx. 1520 mt. Exs. N° 93021702.

Original description
Agaricus (Clitocybe) Pinophilus Pk.
Pileus thin, convex, umbilicate or centrally depressed, glabrous, moist, pale tan-color, paler or alutaceous when dry; lamellae moderately close, subarcuate, adnate or slightly decurrent, whitish; stem equal, stuffed or hollow; glabrous or subpruinose, colored like the pileus; spores nearly elliptical, .0002-.00025 long; odor and taste resembling that of fresh meal.
Plant 1 -2' high, pileus about 1' broad, stem 1" -2" thick.
Ground under pine trees. Albany and Ticonderoga. July and August.

Description

Pileus 1,5-3 cm broad, plane, plano-convex, depressed at centre, then infundibuliform; surface glabrous, looking waxy, hygrophanous; margin thin, slightly projecting; date-brown, brownish-yellow, pale brown, buff, ochre-brown, honey color, pallescent on drying, margin paler.
Lamellae from adnate to broadly adnate or slightly decurrent, rather crowded, anastomosed and intervenose mostly near the lamellulae, L/l = 1/3-5; cream-ochre color, sub-concolor to pileus, hygrophanous.
Stipe 1,5-4 x 0,2-0,5 cm, cylindrical, sometimes compressed, often flexuose, spindle-shaped, slightly swollen towards base, sometimes with white rhizoids at the base of the stem; surface smooth, minutely fibrillose; pale brown, pale fawn, sub-concolor with pileus, paler specially at apex.
Context pale brownish, hygrophanous, sub-concolor with surface, smell spontaneously often subnitrous or weak, taste none.


pi
40 µm
tr
40 µm
st
20 µm
ba
10 µm
sp
M.C.

Clitocybe pinophila: pi = pileipellis, tr = trama, st = stipitipellis, ba = basidia, sp = spores.

Habitat on needles of *Pinus jeffreyi*.

Microscopic features

Spores (4,5)-5-6,4 x 2,8-3,5 µm, ellipsoid, oval, smooth, hyaline, negative in Melzer's reagent. Basidia subcylindric, clavate, stout, often bubble-shaped towards base (up to 3,5-5 µm), with clamp connections, (18)-20-23 x 4,5-6 µm, 4-spored, (rarely 2-spored).
Pileipellis a cutis with cylindrical cells, irregular, 25-75 x 5-10 µm, with several clamp connections. Pigment intracellular, yellow-brownish.
Stipitipellis a cutis of cylindrical hyphae, with rounded terminal elements 75-140 x 5-10 µm.
Trama of the gills made of parallel to subparallel hyphae, 70-120 x 5-12 µm, with several clamps.
Clamps present in all tissues.

Observations: In Peck's description there is no mention of the intervenose or anastomosed lamellae we observed in our specimens. *Clitocybe subbulbipes* shows much the same macroscopical features, but has different habitat. The latter is very close to *C. americana* but differs in its color and the presence of a finely encrusting pigment in the pileipellis. C. californiensis is distinct by the absence of intervenose lamellae and habitat (*Quercus agrifolia*). All these species grow under hardwood trees while the former fruits under conifers (*Pinus jeffreyi*).
It is also close to *C. acerba* Bigelow, but the latter is readily distinguished by its whitish color and smaller spores. The smell as noted by us was not farinaceous but weakly nitrous.
A good color reproduction of *C. pinophila* can be seen in the recently published "Mushrooms of North America" by R. Philips under the name of *C. subbulbipes*.

Clitocybe trullaeformis (Fr.: Fr.) P. Karst., Ryssl. Finl. Skand. Halföns Hattsvamp. 1: 72, 1879.
LAS CHICHIHUAS-KM. 80 CARRETERA LIBRE-ENSENADA-TIJUANA: **10-02-93** leg.: G. Moreno-M.C., det. M.C.
Habitat : on soil with *Rhus integrifolia, Quercus agrifolia*, elev. approx. 420 mt. Exs. N° 93021002.

Coprinus lagopides P. Karst., Ryssl. Finl. Skand. Halföns Hattsvamp. 1: 535, 1879.
LA PINTA-SAN QUINTIN: **13-02-93** leg. et det.: M.C.
Habitat : on sandy soil near the sea. Exs. N° 93021302

Entoloma sericeum (Bull. ex) Quél. **var. sericeum**, Mém. Soc. Emul. Montbéliard, sér. II, 5: 119, 1872.
LAS CHICHIHUAS-KM. 80 CARRETERA LIBRE-ENSENADA-TIJUANA: **10-02-93** leg.: M.C., det.: A. Galbusera
Habitat : on grass near *Rhus integrifolia*, elev. approx. 420 mt. Exs. N° 93021006

Entoloma lividoalbum (Kühn. & Romagn.) Kubicka, Ceska Mykol. 29: 27, 1975.
CAÑADA VERDE-KM.106 CARRETERA TECATE MEXICALI: **06-02-93** leg. et det.: M.C.
Habitat : *Quercus agrifolia*, elev. approx. 1000 mt. Exs. N° 93020602.

Laccaria bicolor (R. Mre.) Orton, Trans. Br. mycol. Soc. 43: 177, 1960
CAÑON DE STA.ROSA-KM.78 CARRETERA LIBRE-ENSENADA-TIJUANA: **10-02-93** leg. et det.: M.C.
Habitat : *Quercus agrifolia* near the Sta. Rosa's river, elev. approx. 420 mt. Exs. N° 3021005.

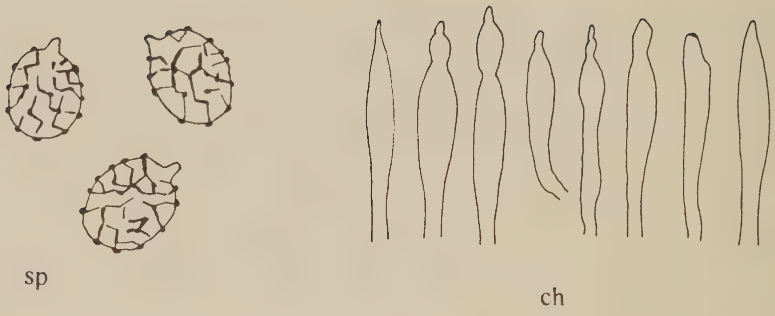
Lactarius alnicola A.H. Smith **var. alnicola**, Brittonia 12: 319, 1960.

IGNACIO ZARAGOZA-KM.65 CARRETERA LIBRE-ENSENADA-TECATE: **06-02-93** leg. et det. A.G.
Habitat: *Quercus agrifolia*, elev. approx. 350 mt. Exs. N° 93020609.

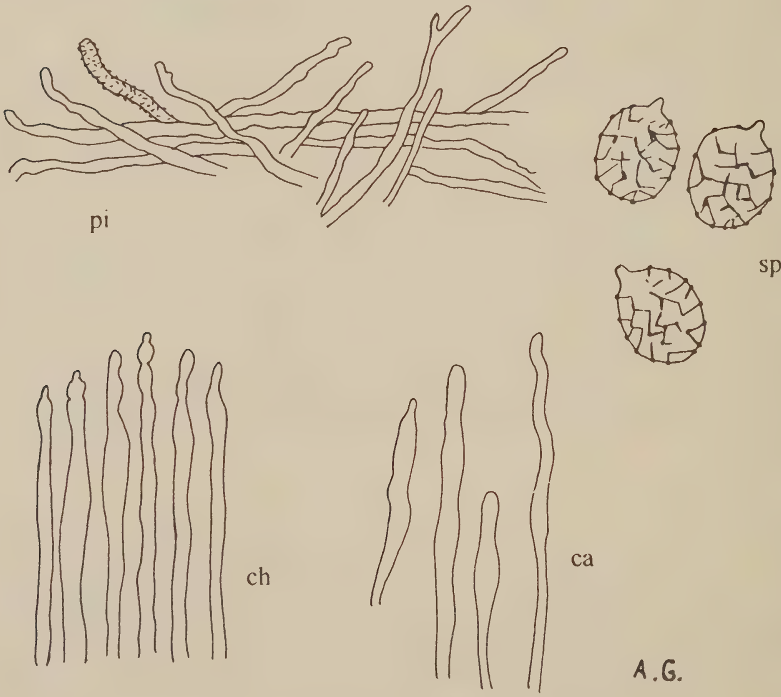
Original description
Pileus 8-15 cm latus, convexo-depressus, glutinosus, luteus, ad marginem pubescens; sapor forte acris; latex albus; lamellae tactu luteae. Specimen typicum legit A.H. Smith (N° 59648), 5 Aug. 1958, Warm Lake, Idaho, U.S.A. (MICH).

Description

Pileus 5-12(18) cm, at first convex, broadly depressed, margin inrolled and slightly velvety, in age often nearly plane, surface slightly viscid, zonate when young, ochraceous yellow, paler at the margin, like *L. zonarius*.
Lamellae adnate-decurrent, arcuate, close to crowded, narrow, cream whitish, many lamellulae present.
Stipe 3-7 x 2-3 cm, cylindrical, broadened at apex, somewhat smaller at the base, stuffed then hollow, pubescent, whitish to cream yellowish, with rare yellow scrobiculation.
Context white, yellow when cut, taste at first mild becoming somewhat acrid only after some minutes. Latex white, copious, turning citron yellow instantly.



Lactarius argillaceifolius var. megacarpus: sp = spores, ch = cheilocystidia



Lactarius alnicola var. alnicola: pi = pileipellis, sp = spores, ch = cheilocystidia, ca = caulocystidia

KOH yellow on pileus cuticle, citron yellow on flesh.
Habitat: under *Quercus agrifolia.*

Microscopic features

Spores 6,5-9,5(10) x 6-9 µm, ellipsoid to subglobose, with a partial reticulum, prominences relatively high.
Basidia 4-spored, clavate, 40-50 x 9-13 µm.
Cheilocystidia (30)-50-90 x 3-8 µm, clavate, narrow, with acuminate apex. Caulocystidia in KOH yellow.
Pileipellis an ixocutis of 3-6 µm wide, encrusted hyphae.

Observations: The european *L. zonarius* is very close, but is readily distinguished by the whitish latex. Other species of *Lactarius* which resemble our species are: *L. payettensis, L. yazoonensis, L. olympianus, L. psammicola fm. glaber, L. alnicola var. pitkinensis* and *L. alnicola var. pungens.*

Lactarius argillaceifolius Hesler & Smith **var. megacarpus** Hesler & Smith
North Am. Sp. of Lactarius: 369, 1979.

KM.15 AL PARQUE NACIONAL COSTITUCION DEV.KM. 55 - ENSENADA-S.FELIPE: **17-02-93** leg.: A.G.-M.C.-C. Sigüenza-M. Lizárraga, det. A.G.-M.C.
Habitat: *Quercus agrifolia, Quercus dummii, Rhus integrifolia*, elev. approx. 1100 mt. Exs. N° 93021701

Original description
Pileus 14-27 cm latus, viscidus, azonatus, luteolus vel ad marginem pallido-avellaneus. Latex albus, constans, branchias colore brunnaceotingens. Lamellae adnatae, paene subdistantes, luteolae. Stipes 16-20 cm longus, 40-50 mm crassus, leviter viscidus, basi albus, apice sordide luteolus. Sporae 7.5- 10.5 x 6.5-8 µ. Specimen typicum in Herbarium University of Tennessee, Thiers 18556 (TENN 35424), legit Prope Santa Barbara, California, 28 Jan 1967.

Description

Pileus 12-22 cm, convex, plano-convex, regular to very irregular, with deep central depression. Pileal covering smooth, slightly and finely velvety when dry, margin hardly viscid when moist, strongly inrolled, extremely wavy, irregular, indented, pubescent and strongly striate. Often with soil particles overall. Grayish violet, lilac lead-gray, with buff tinges, disc with lighter ochraceus color. Margin silvery gray. Reminiscent of *Russula cyanoxantha*.

Lamellae adnate, slightly decurrent, at times forked at stipe attachment, crowded. L/l = 1/5-7, of medium thickness, narrow. Argillaceous cream, dark cream, staining brownish, vinaceous gray when touched. Latex very acrid after about 10 seconds, cream to ivory cream.

Stipe 8-12 x 3-6-(8) cm, cylindrical, slightly ventricose, very irregular, canaliculate, compressed, tapering at base, hollow, stuffed. Surface smooth, finely pubescent, hardly viscid when wet, at times scrobiculate, whitish ochraceous-cream, staining brownish yellow.

Context tough in outer layer of stipe, pithy-cottony inside, white, cream, sometimes almost pink, subconcolor under the cuticle. Taste slightly acrid after a short while, odor slightly Pentalomide-like (cimicic).

Habitat under Californian oaks, gregarious to caespitose.

Microscopic features

Spores 8-9(10) x 6,5-7,5 µm, ellipsoid, ornamentation of fine lines not forming a complete reticulum.

Basidia 4-spored.

Cheilocystidia fusoid with acuminate apex, irregular, with one or more constriction toward the apex.

Pileipellis an ixotrichodermium formed by a tangle of hyphae 2.5-4.5 µm wide, with rounded and/or capitulate end-cells, some dissepiments and branchings with yellowish intracellular pigment and pieces of blackish brown extracellular pigment.

Observations: The pileipellis structure, undoubtedly trichodermial according to our observation, does not fit with the original description.

Macrolepiota rachodes (Vittadini) Singer **var. bohemica** (Wichansky) Bellù & Lanzoni, Beitr. Kenn. Pilze Mittel. III: 191, 1987.
RANCHO LOS JACARANDAS-CAÑON LAS ANIMAS: **07-02-93** leg.: N. Ayala-M. Lizàrraga, det.: N.A.-M.C.
Habitat : under *Sambucus mexicanus*, elev. approx. 200 mt. Exs. N° 93020708.

Micromphale inodorum (Pat.) Dennis, Kew Bull. 15, 1: 90, 1961.
LAS CHICHIHUAS-KM. 80 CARRETERA LIBRE-ENSENADA-TIJUANA: **10-02-93** leg.: A.G., det.: A.G.-M.C.
Habitat : *Heteromeles arbutifolia*, elev. approx. 420 mt. Exs. N° 93021004.

Nothopanus cf. lignatilis (Pers.: Fr.) Bon
RANCHO LOS JACARANDAS-CAÑON LAS ANIMAS: **07-02-93** leg. et det.: M.C.
Habitat : on *Opuntia litoralis*, elev. approx. 200 mt. Exs. N° 93020704.

Omphalina rosella (Lge.) Moser, Helmut Gam's Kl. Krypt. Mitt. II: 58, 1953.
Basionymum (= *Omphalia rosella* Lge., Dansk Bot. Arkiv 6(5): 14).
RANCHO LOS JACARANDAS-CAÑON LAS ANIMAS: **07-02-93**
Habitat : on grasslands near *Q. agrifolia*, elev. 200 mt. Exs. N° 93020701.

LAS CHICHIHUAS-KM. 80 CARRETERA LIBRE-ENSENADA-TIJUANA: **10-02-93**
Habitat : on grassland, elev. approx. 420 mt. Exs. N° 93021018.

KM.71-SAN QUINTIN-STA.INES: **13-02-93**
Habitat : grass on granitic soil, elev. approx. 30 mt. Exs. N° 93021301,leg. et det. M.C.

Original description

Small. Cap 0.7-1.5cm., membranaceous, at first umbilicate with incurved edge, then infundibuliform, of a pale and somewhat dingy pink color (without striation), centre slightly dirt-brownish. The edge is somewhat irregularly crenato-fimbriate and slightly rugoso-plicate. When dry the color is paler and duller. Gills deeply decurrent rather narrow, somewhat furcate, rather distant, pale pink. Stem short (1-2 cm. x 1½ mm.), at first pinkish, then whitish, glabrous, somewhat wavy, not particularly tough and not hollow.
Spores cylindrical-ellipsoid, obliquely pedicellate, 7½-9 x 4-4½ µ. Basidia 4-spored. Cystidia scattered, short hairshaped about 4 µ thick (the base, which is imbedded in the tissue of the gill, about 6 µ).
Fig. specim. (D.A. 292): "Slukefter" near Odense, in a park, gregarious on old lawn, (light soil), Oct. 1921 (and 23).
Pileus diametro 0.7-1.5 cm., membranaceus, umbilicatus (margine incurvato) dein infundibuliformis, laevigatus, roseolus (pars centralis sordide subfulva), margine (in adultis) crenato-fimbriato vel rugoso-plicato, pallescens; lamellis longe decurrentibus, angustis subfurcatis, subdistantibus, pallide roseolis. Stipes brevis (1-2 cm. x 1½ mm.), roseolus (in adultis albus), glabratus. Sporae et cystidia ut supra. -

Description

Pileus 0,5-1,5-(2) cm broad, convex to concave, usually deeply umbilicate, infundibuliform, with slightly to distinctly involute margin when young, then straight or reflexed and fringed in old specimens; surface slightly velvety, dry,

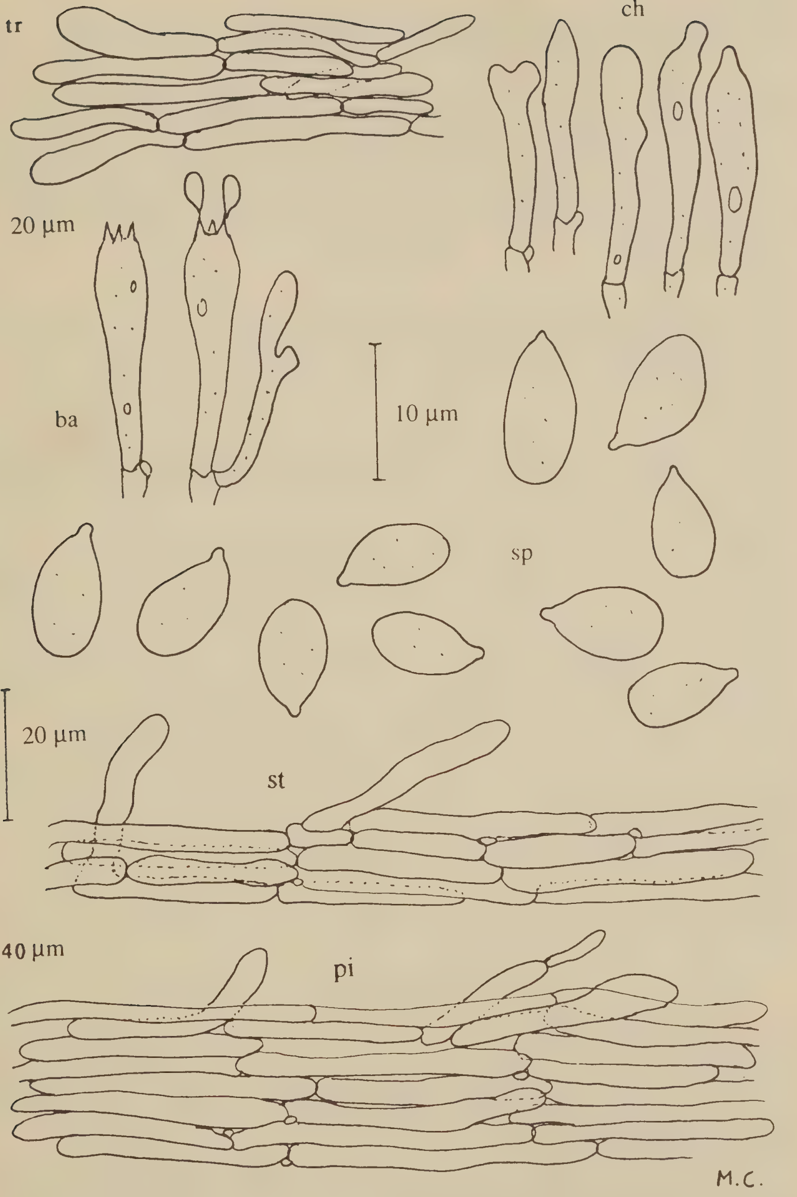
color very variable, first dirty white or pale ochre, then whitish cream, yellowish cream, pinkish white, pinkish ochre, with centre brownish when mature.
Lamellae deeply decurrent, arcuate, anastomosed, rather distant, 2- 3-furcate, L/l = 1/1-3, white, cream, pinkish, then ochre with tender pinkish tinge, with heteromorphous and sometimes pink or brown edge.
Stipe 2-3 x 0,1-0,2 cm, cylindrical, solid, smooth, dry, sometimes broadened at base, subconcolor with pileus.
Habitat terrestrial in groups in grasslands, often on rather poor, sandy soil; near *Quercus agrifolia* and *Skinus mollis.*

Microscopic features

Spores (6,5)-7-9-(9,5) x 4,5-5,5 µm, subamygdaliform, subpyriform, ellipsoid, with evident hilar apiculus, smooth. Basidia clavate, subcylindrical, 30-35 x 7-9 µm, 4-spored, sterigmata 4-5 x 1,5-2 µm wide, with clamp connections at base. Cheilocystidia making the edge heteromorphous, conspicuous, clavate, mucronate, apically forked (obtuse), cylindrical, irregular, hyaline.
Pileipellis a cutis with subcylindrical, subellipsoid elements, with rounded, sometimes free terminal cells, of variable diameter and rather versiform 30-250 x 5-15 µm.
Stipitipellis a cutis with elements 50-75 x 5-7,5 µm, sometimes with subcylindrical, free elements, with rounded terminal cells. Clamp connections present at every septum.
Trama of the gills with mostly filamentous and regular hyphae, rather dense, with subparallel arrangement, formed mainly by subcylindrical, subellipsoid elements 25-40 x 5-9 µm.
Clamps present in all tissues.

Observations: *O. rosella* resembles *O. ericetorum* (= *O. umbellifera*) but differs mainly by the absence of clamp connections and the presence of cheilocystidia. In addition it differs from *O. subclavata* (Peck) Murrill among other characters by the total absence of yellow-olive tinges. Another species that is very close, but has white colors and habitat in coniferous woods is *O. californiensis. O. jalapensis* has different spore-size (5 x 3,5 µm).
Murrill published several species of *Omphalia* in 1916 (*O. Mac Murphyi, O. Bakeri, O. tepeitensis, O. niveicolor* ecc.), but we were unable to find our species among them because the descriptions are either very incomplete or too short.

Omphalotus olivascens Bigelow, Miller & Thiers var. **indigo** Moreno, Esteve-Raventos, Pöder & Ayala (Mycotaxon in print).
CAÑON DE STA.ROSA-KM.78 CARRETERA LIBRE-ENSENADA-


tr
ch
20 µm
ba
10 µm
sp
20 µm
st
40 µm
pi
M.C.

Omphalina rosella: tr = trama, ch = cheilocystidia, ba = basidia, sp = spores, st = stipitipellis, pi = pileipellis

TIJUANA: **10-02-93** leg.: M.C., det.: G. Moreno-M.C.
Habitat : *Quercus agrifolia*, elev. approx. 420 mt. Exs. N° 93021003.

Observations: For a long time this species was confused with *O. olearius* or *O. illudens*. The abundance of specimens of *O. olivascens* in all stages of development (with pileus diameter up to 35 cm) collected in Baja California, along with our previous experience of both Mediterranean species, enabled us to confirm the validity of the species proposed by Bigelow, Miller & Thiers in Mycotaxon (1976).

Pluteus nanus (Pers.: Fr.) Kummer, Der Führer in die Pilzk.: 98, 1871.
PLAYA HERMOSA-ENSENADA: **12-02-93** leg. et det.: M.C.
Habitat : *Haplopapus sp., Pluchea sericea* on marsches with grass. Exs. N° 93021201.

Psilocybe coprophila (Bull.: Fr.) Kummer, Der Führer in die Pilzk.: 71, 1871.
LAS CHICHIHUAS-KM. 80 CARRETERA LIBRE-ENSENADA-TIJUANA: **10-02-93** leg. et det.: M.C.
Habitat : on dung, elev. approx. 420 mt. Exs. N° 93021001.

Tricholoma columbetta (Fr.: Fr.) Kummer, Der Führer in die Pilzk.: 131, 1871.
KM.15 AL PARQUE NACIONAL COSTITUCION DEVIACION KM.55-ENSENADA-S.FELIPE: **17-02-93** leg.: G. Giana, det.: A.G.
Habitat : *Quercus agrifolia*, elev. approx. 1100 mt. Exs. N° 93021703.

Volvariella gloiocephala (DC.: Fr.) Boekh. & Enderle, Beitr. Kenntn. Pilze Mitteleur. 2: 78, 1986.
RANCHO LOS JACARANDAS-CAÑON LAS ANIMAS: **07-02-93** leg. et det.: A.G.-M.C.
Habitat : on grasslands, elev. approx. 200 mt. Exs. N° 93020703.

Acknowledgements

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We would like to express our appreciation to members of the Universidad de Alcalà de Henares - Madrid : Dr. Miriam Blanco, Dr. C. Illana and Dr. R. Galan; to the members of Università di Trieste : F. Bersan, Dr. G. Giana, Dr. M. Sarasini and Amer Montecchi for collecting fungi.

Thanks also to Biol. C. Sigüenza Lopez for the determinations of host plants and for supplying valuable field information and personal observations.
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All of these people were also wonderful partners during various trips to several localities in Baja California.
We wish to thank Prof. Dr. M. Moser for the review of this manuscript.

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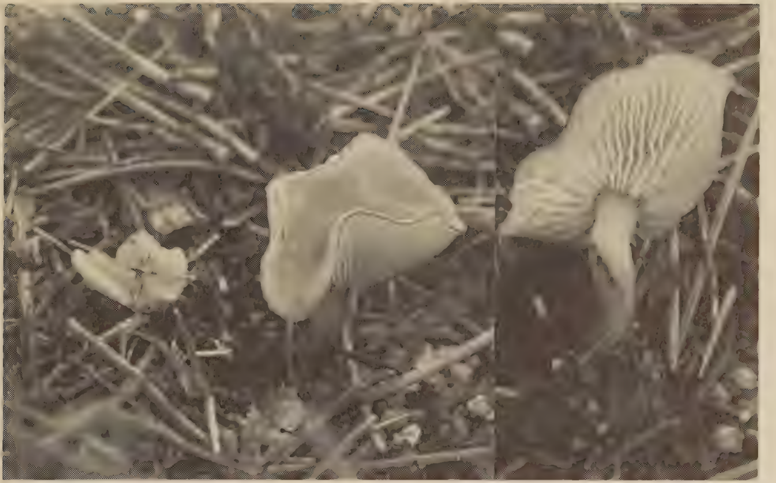
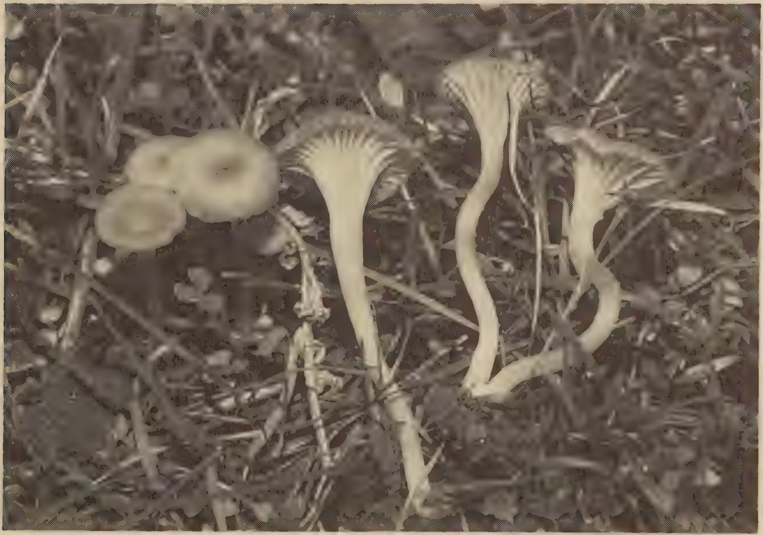


Clitocybe pinophila (Peck) Saccardo



Omphalina rosella (Lange) Moser

MYCOTAXON

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PHAULOMYCES SIMPLOCARIAE SP. NOV. (ASCOMYCETES, LABOULBENIALES) FROM SIMPLOCARIA SEMISTRIATA (COLEOPTERA, BYRRHIDAE)

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SUMMARY

A new species of the genus *Phaulomyces* (Ascomycetes, Laboulbeniales), parasitic on *Simplocaria semistriata* Fabricius (Coleoptera, Byrrhidae) is described and illustrated: *Phaulomyces simplocariae* sp. nov.

INTRODUCTION

The genus *Phaulomyces* from Thaxter (1931) occurs on various host-families and comprises, including the new species, eleven species. Four species have been reported in Europe (Santamaria et al, 1991; Santamaria, 1992) i.e.: *P. octotemni* (T. Majewski) I.I.Tav. on *Octotemnus* (Coleoptera, Ciidae) from Poland (Majewski, 1973c); *P. perparvus* Santamaria on *Atomaria* (Coleoptera, Cryptophagidae) from Spain (Santamaria, 1992), *P. euaestheti* (Thaxt.) I.I.Tav. on *Euaesthetus* (Coleoptera, Staphylinidae) from Germany (Scheloske, 1969) and *P. denticulatus* Santamaria on *Phloeocharis* (Scotodytes) from Spain (Santamaria, 1992).

Phaulomyces simplocariae sp. nov. was found on *Simplocaria semistriata* Fabricius, 1794, it is the first Laboulbeniaceous parasite found on Byrrhidae (Coleoptera). According to Benjamin (1989) all the previous records on Byrrhidae, i.e. *Aporomyces* and *Cantharomyces bordei*, were of the family Limnichidae *(Limnichus, Byrrhinus, Pelochares).*

The genus *Phaulomyces* is recognised by a two-celled primary receptaculum bearing two or three appendages that arise from the basal appendage cell, which is supported by cell III (Tavares, 1985). The basal appendage cell usually bears a sessile antheridium. The perithecium has three tiers of outer wall cells of unequal height and inconspicuous cell-walls in its basal cells. All the specimens were mounted in Amann's medium as described in De Kesel (1989), they are stored in BR. The drawings were made with a Leitz Dialux 20 EB (drawing tube).

DESCRIPTION

Phaulomyces simplocariae De Kesel sp. nov. (Figs. 1A, 1B, 1C)

Thallus hyalinus, praeter perlucidos gilvo-fuscos parietes cellularum basalium perithecii. Fungus monoecius. Receptaculum e 3 cellulis compositum. Cellula basalis paulo elongata, ad basim angustata. Cellula II latior quam longior, cellulam pedunculi perithecii (cell.VI) et cellulam II' ferens. Cellula II' et cellula pedunculi perithecii lateribus connatae.

Receptaculum maturum 1 perithecium praeditum. Cellula pedunculi perithecii (cell. VI) isodiametra. Parietes cellularum basalium perithecii in maturis peritheciis vix distinguibiles. Paries perithecii ex cellulis altitudine inaequalibus compositus. Perithecium, symmetricum, fusiforme, apicem paulo differentiatum. Cellula II' appendicem ex cellula basalis una composita ferens, ipsa 1 (-2) antheridiis ampuliformis et 2-4 sterilibus ramis instructa; rami 0-2 ramulis praediti.

Longitudo a basi usque ad apicem perithecii: 95-125µm (N=61); perithecium: 60-80µm X 16-24µm magnum (N=61); appendices ad 85-255(-400)µm longae (N=61); antheridia: 11-17µm longae (N=29); ascosporae: 30µm longae (N=3).

HOLOTYPUS: ADK670 (BR), die 7.III.1993, in locis Bornemum (Antverpia, Belgia), habitat ad sylva de Notelaria (I.F.B.L: C4.54.13), ad elytrum Simplocariae semistriatae Fabricius (♂) lectus.

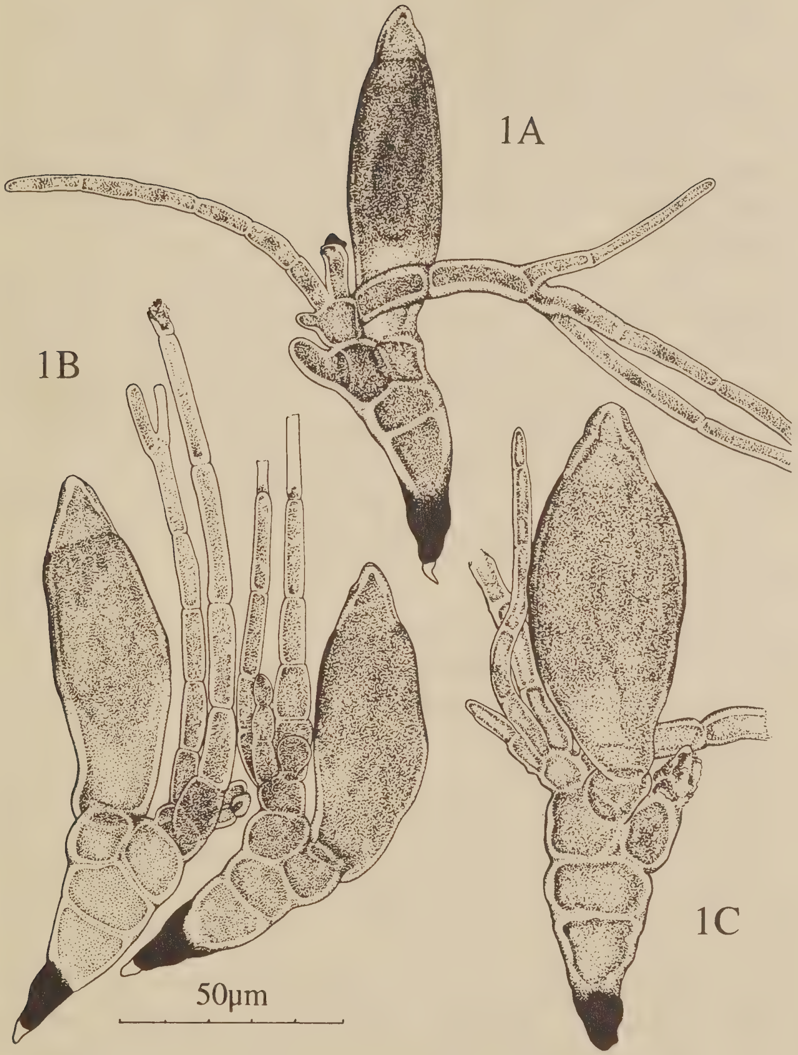

Figure 1. *Phaulomyces simplocariae* sp. nov. - 1A. Holotypus, mature thallus with antheridium, slide ADK670. - 1B. Paired thalli with antheridia, slide ADK675a. - 2C. Thallus with second perithecium born on cell II', slide ADK666b. - Scale = 50µm - [illegible] mounted in Amann's medium.

Thallus hyaline, except for the first tier of outer wall cells of the perithecium, which is pale yellowish-brown. The receptacle consists of three superposed cells. The basal cell (cell I) is slightly elongated and becomes narrower towards the black foot. The suprabasal cell (cell II) is broader than high and bears the stalk cell of the perithecium (cell VI) and a somewhat larger third receptacle cell (cell II'). Cell II' and cell VI are connected laterally.

The mature thallus has one, rarely two, stalked, symmetric, fusiform perithecia with an undifferentiated apex and hardly distinguishable basal cells. The length of the basal cells can vary considerably (compare thalli in figure 1). The perithecial stalk cell (cell VI) is usually isodiametric. The outer wall cells of the perithecium are of unequal height and have inconspicuous cell walls. The first tier is much taller than second and third together. The usually single, relatively small isodiametric basal cell of the primary appendage arises at the apex of cell II'. It bears two, sometimes three or four, sterile, simple or moderately branched appendages and one or two sessile antheridia.

Thalli with a spent or damaged perithecium can produce a second perithecium. Old thalli usually show a precursors of a second perithecium, i.e. procarp, on the inner or outer margins of cell II' (Fig. 1A).

Measurements: Total length from foot to perithecial apex: 95-125µm (N=61); Length and width of perithecium with stalk cell: 60-80µmX16-24µm (N=61); Length antheridia: 11-17µm (N=29); Length appendages 85-255µm(400µm) (n=61); Length spore: 30µm (N=3).

HOLOTYPE: Belgium (prov. Antwerpen), Bornem, Domein de Notelaer (I.F.B.L: C4.54.13), deciduous forest, 7.III.1993, on *Simplocaria semistriata* Fabricius (♂), elytrae. Leg. A. De Kesel, (BR) ADK670.

PARATYPES: Ibid. on *S. semistriata* (♀) elytrae. Leg. A. De Kesel, (BR) ADK666a, ADK666b. Ibid. on *S. semistriata* (♂), abdomen. Leg. A. De Kesel, (BR) ADK667. Ibid. on *S.*

semistriata (♂), elytrae. Leg. A. De Kesel, (BR) ADK668a, ADK668b. Ibid. on *S. semistriata* (♂), right elytron. Leg. A. De Kesel, (BR) ADK669. Ibid. on *S. semistriata* (♂), abdomen and elytrae. Leg. A. De Kesel, (BR) ADK671a, ADK671b. Ibid. on *S. semistriata* (♂), abdomen, elytrae and femur. Leg. A. De Kesel, (BR) ADK672a, ADK672b, ADK672c, ADK672d. Ibid. on *S. semistriata* (♂), abdomen. Leg. A. De Kesel, (BR) ADK673a, ADK673b. Ibid. on *S. semistriata* (♂), elytrae. Leg. A. De Kesel, (BR) ADK674.

Belgium (prov. Antwerpen), Bornem, Domein de Notelaer (I.F.B.L: C4.54.13), deciduous forest, 21.II.1993. on *S. semistriata* (♀), abdomen and elytrae. Leg. A. De Kesel, (BR) ADK675a, ADK675b. Ibid. on *S. semistriata* (♂), right elytron. Leg. A. De Kesel, (BR) ADK676. Ibid. on *S. semistriata* (♂), right elytron. Leg. A. De Kesel, (BR) ADK677.

DISCUSSION

The host, *S. semistriata,* is a widely distributed species, it occurs in various habitats from subtropical and temperate zones (Freude et al., 1965). In Belgium it is a common species in deciduous forests. The adults and larvae feed on rhizoids of mosses. The adult beetles are active from september till april (De Kesel, unpubl. data). The beetles were captured with pitfalls. All specimens come from a relatively humid deciduous forest near a river. One infested specimen was found in coastal dunes.

Phaulomyces simplocariae is a relatively small species and is, considering the hairiness of the hosts' integuments, easily overlooked. It usually grows in pairs on the elytrae and abdomen. The presence of paired perithecial thalli indicates that the fungus is monoecious.

Different infection patterns between male and female beetles were observed, they suggest that the parasite is transmitted during copulation. Males are mostly infested on their abdomen, females on the caudal region of their elytrae. Statistical

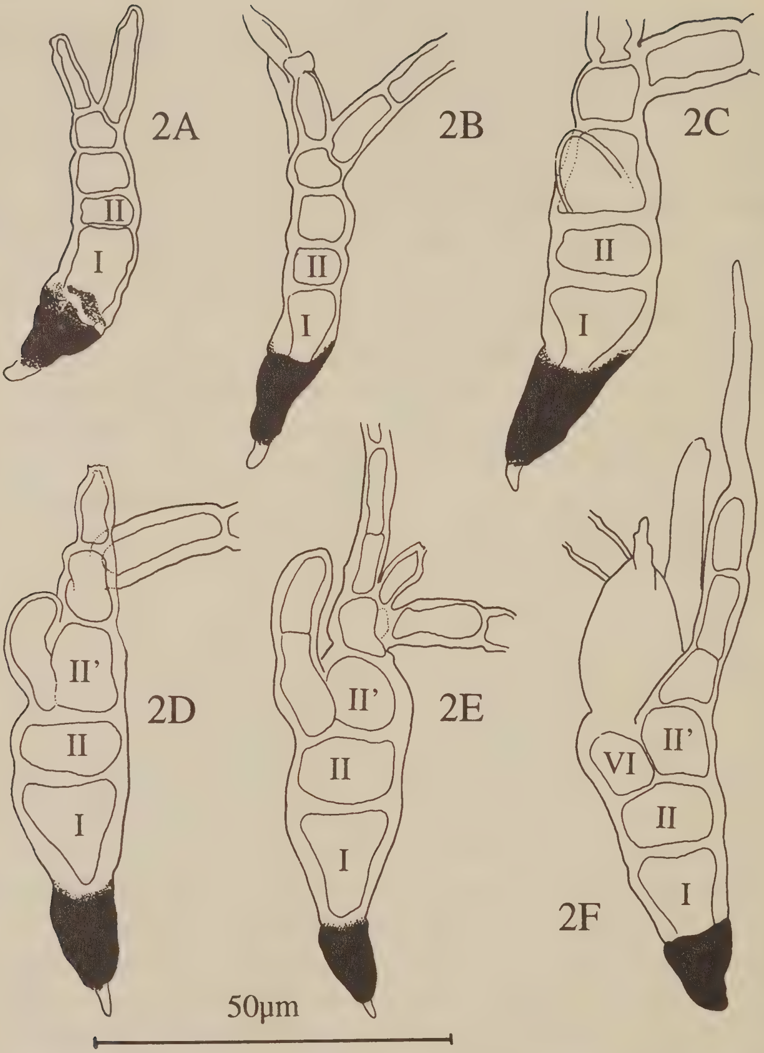

Figure 2. *Phaulomyces simplocariae* sp. nov. - 2A. Immature thallus with primary appendage and antheridium, slide ADK667. - 2B. Idem, slide ADK673b. - 2C. Immature thallus with the perithecial initial cell formed by cell II', slide ADK671b. - 2D. Idem, slide ADK671b. - 2E. Immature thallus with procarp, slide ADK675b. - 2F. Thallus with young perithecium and trichogyne. - Scale = 50µm - all mounted in Amann's medium.

treatments and more observations should be made to ascertain this.

P. simplocariae belongs in the subtribus Euphoriomycetinae since its mature perithecium has non persistent basal cells and the tiers of outer wall cells are of unequal height.

The basal appendage can be considered as the upper receptacle cell (cell III) like in *Meionomyces* Thaxt were cell III bears an antheridium and the appendages. We stress that some features of *P. simplocariae* indicate that *Phaulomyces* and *Meionomyces* are strongly related. Since cell III is not that small and a foot extension is lacking we thought it save to place this new species in *Phaulomyces*.

Some drawings were made of immature thalli (Fig. 2A, 2B, 2C, 2D, 2E, 2F), they show that the procarp is formed by the cell above cell II, i.e. cell II'. Wether this is the case in all other *Phaulomyces* species should be studied.

Fig. 1A (Holotype) shows a lateral outgrowth on cell II', this outgrowth is probably a second procarp, it occurs frequently in mature thalli. Two thalli were observed bearing a second perithecium on the latero-apical side of cell II' (Fig. 1C). Both thalli clearly illustrate that a second perithecium is formed only when the first perithecium is spent or breaks off. The possibility that habitat characteristics or climatological factors might influence the development of a second perithecium should be considered.

Thalli, from the newly described species, resemble *Phaulomyces octotemni* (T. Majewski) I.I.Tav. found on *Octotemnus* (Ciidae) by Majewski (1973). *P. simplocariae* differs in two respects from *P. octotemni;* the mature thallus is taller and the perithecium is symmetrical.

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MYCOTAXON

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STOMIOPELTIS GLOCHIDIICOLA SP. NOV.

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A black, scutellate, micropeltaceous fungus was collected on leaves of *Glochidion hohenackeri* Bedd. in forests of Mahabaleshwar (M.S.) (elev. 1300 m.s.l.). The fungus showed a non-radiate nature of the scutellum which wasmade up of pseudoparenchymatous tissue with lobed cells, presence of free superficial mycelium with brown, branched hyphae, orbicular thyrothecia, bitunicate asci with hyalodidymo- spores and septate, branched pseudoparaphyses. All these characters showed that the collection belonged to the genus *Stomopeltis* Theiss. & Syd. emend. Luttrell.

The genus is typified by *S.aspersa* (Berk.)Theiss., collected on leaves of a species of Lauraceae from India and described by Theissen (1914). Originally the genus was restricted for thyrothecia with a single locule but Luttrell (1946) emended the description to include *S. polyloculata* Luttrell with several locules per thyriothecium. He stressed that since variations in number of locules per ascocarp occurred in a single species of the genus, the inclusion of multiloculate species under *Stomiopeltis* with suitable expansion of generic limits was justifiable and variation in number of locules per ascocarp should not be considered as an important criterion for separation at generic level. His collection on *Arundinaria tetae* (Walt.) Muhl. with multiloculate thyrothecia was thus included by him in this genus as *Stomiopeltis polyloculata.*

There are more than 25 species described in *Stomiopeltis* so far. Speciation is based entirely on comparative morphology of various structures like ascocarps, asci and ascospores.

After monographic work by Luttrell (Luttrell, 1946), who described the then known 7 species, several species have been added to the genus *Stomiopeltis* (Müller & v. Arx, 1962, Ellis, 1977).

Multiloculate thyrothecia with superficial mycelium, non-radiate scutellum, didymosporous ascospores in the present collection confirmed its inclusion under *Stomiopeltis* (Berk.) Theiss. emend. Luttrell.

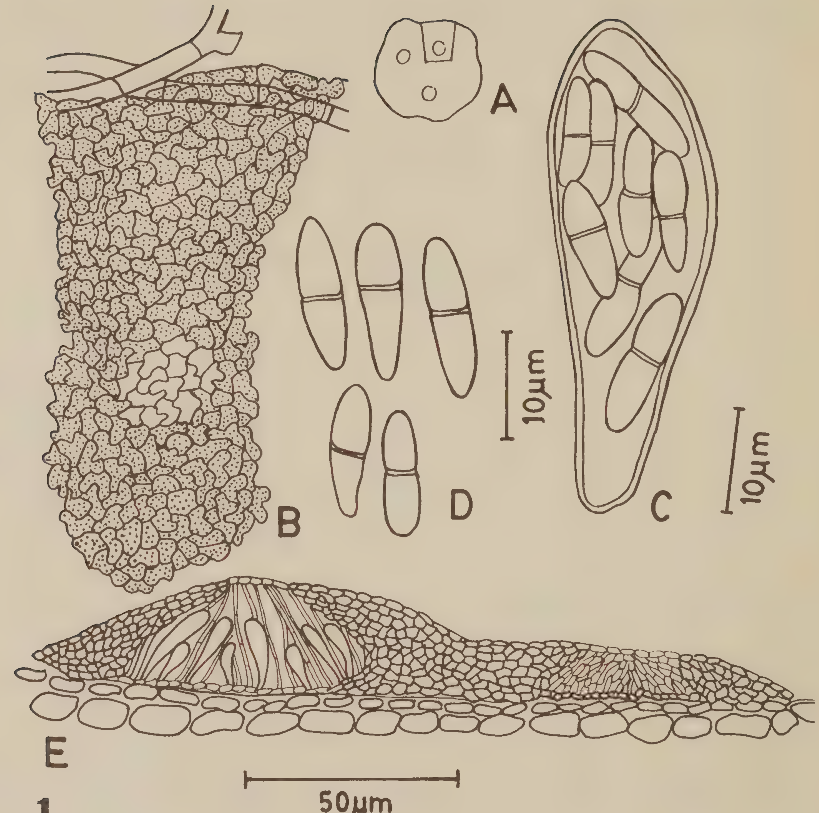

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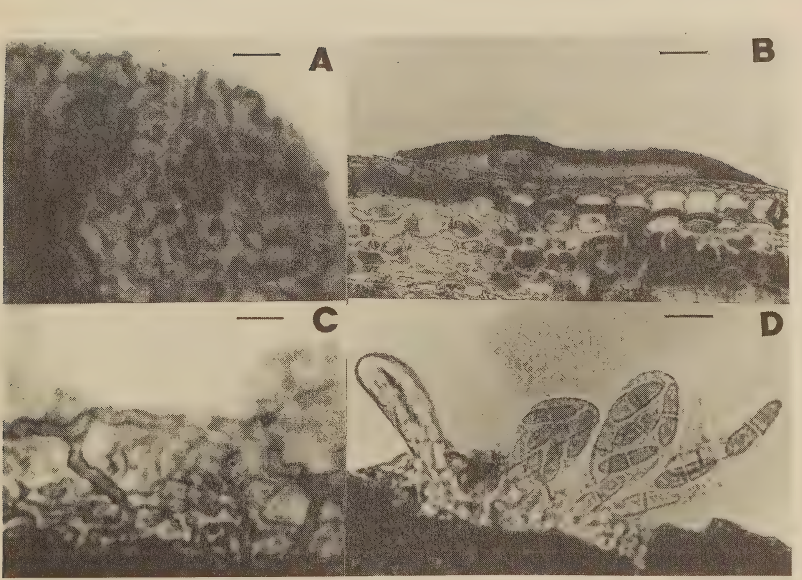
Fig.1.*Stomiopeltis glochidiicola* Pande & Rao
A: thyriothecium; B: a part of scutellum; C: Ascus;
D: Ascospores; E:Section of a thyriothecium.

Fig. 2.:Photomicrographs of *Stomiopeltis glochidiicola* Pande & Rao showing:
A: A part of the scutellum showing non-radiate, irregular cells;
B: superficial branched hyphae; C: Section of a thyriothecium
D: Asci and Ascospores.
Bar = 10 µm (A,C,D); Bar = 20 µm (B)

Table 1: Comparison of *Stomiopeltis* species with multiloculate thyriothecia

Species	Scutellum	Locule no.	Asci	Ascospores
S. polyloculata Luttrell	286-680 µm	2-16	-	13.5-21 x 4.1-4.8 µm (av. 17.25 x 4.4 µm) (l/b = 3.9)
S. glochidiicola Pande & Rao	160-210 µm	2-5	42-50 x 17-21 µm	12-15 x 3-6 µm (av. 13.5 x 4.5 µm) (l/b = 3.0)



After the original collection of *S. aspersa* by Berkeley (Theissen, 1914) from Khasi Hills, Assam, the genus had not been recollected from India until we collected this specimen on living leaves of *Glochidion hohenackeri* Bedd. (Euphorbiaceae).

Comparison with the only multiloculate species, *S. polyloculata* Luttrell, the present material showed to be distinct. It is described here as a new species (Table 1).

Stomiopeltis glochidiicola sp. nov. Pande & Rao (Fig.1 & 2)

Mycelium superficial, composed of brown, branched hyphae, forming minute brownish spots on leaf surface. Ascocarps subcuticular, dimidiate, scutellate, orbicular, 160-210 µm in diam., multiloculate; locules opening through separate ostioles. Shield (scutellum) pseudoparenchymatous, non-radiate, composed of irregularly lobed brown cells, becoming plechtenchymatous towards margin, merging into mycelial network. Asci pseudoparaphysate, clavate, bitunicate, octosporous, produced with bases towards rim and pointing towards central ostiole, 42 - 50 x 17 - 21 µm. Ascospores hyaline, one-septate, non-constricted at septum, rounded at both ends, 12 - 15 x 3 - 6 µm (l/b = 3.0).

Collected on living leaves of *Glochidion hohenackeri* Bedd. at Mahabaleshwar (M.S., India) (el. 1300 m.s.l.), dt. 6.i.1982, AMH 7149 (Holotype).

Maculae brunneae, orbiculares. Mycelium superficiale. Ascomata subcuticularia, 160 - 210 µm diam., multiloculata. Loculae 2 - 5, ostiolatae. Scutellum pseudoparenchymaticum, non-radiatum, ex celluis brunneis irregulariter lobatis, marginam versus ex cellulis plectenchymatibus formatum. Asci pseudoparaphysatibus, clavati, bitunicati, octospori, 42 -50 x 17 - 21 µm. Ascosporae hyalinae, uniseptatae, non-constrictae, ad apicem rotundatae, 12 - 15 x 3 - 6 µm.

In foliis viventibus *Glochidii hohenackeri* Bedd., loco: Mahabaleshwar (M.S., India), dt. 6.Jan.1982, holotypus lectus ad AMH subnumero 7149.

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ADDITIONAL NEW SPECIES AND NEW REPORTS OF PERTUSARIA (LICHENISED ASCOMYCOTINA) FROM NEW ZEALAND WITH A REVISED KEY TO THE CORTICOLOUS SPECIES IN NEW ZEALAND.

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ABSTRACT: The species *Pertusaria barlettii* Archer & Elix, *Pertusaria celata* Archer & Elix, *Pertusaria hadrospora* Archer & Elix, *Pertusaria parvula* Archer & Elix, *Pertusaria psoromica* Archer & Elix, *Pertusaria scutellifera* Archer & Elix and *Pertusaria sporellula* Archer & Elix are described as new; *Pertusaria leucoplaca* Müll.Arg., *Pertusaria schizostomella* Müll.Arg., *Pertusaria subisidiosa* Archer, *Pertusaria subplanaica* Archer & Elix, *Pertusaria thamnolica* Archer and *Pertusaria velata* (Turn.) Nyl. are reported as new to New Zealand. *Pertusaria albissima* Müll.Arg. and *Pertusaria alboatra* Zahlbr. are re-instated into the New Zealand lichen flora. A key to the New Zealand corticolous species of *Pertusaria* is given.

INTRODUCTION

The lichen genus *Pertusaria* in New Zealand was reviewed by Galloway (1985) and an account of the saxicolous species common to Australia and New Zealand has been given (Archer & Elix 1993). An examination of additional recent corticolous specimens from New Zealand [from AK, AKU, CHR, OTA and WELT] has shown the presence of both undescribed taxa and species new to New Zealand and these are reported here. The techniques used for the examination of specimens have been described previously (Archer 1991); the chemistry of the majority of the specimens examined was confirmed by liquid chromatography (Elix & Venables 1993). The spore descriptions follow the nomenclature of Dibben (Dibben 1980: 10). The figures illustrate holotypes and, unless noted otherwise, the type specimens cited have been seen. A key to the New Zealand corticolous species of *Pertusaria* is given.

Pertusaria bartlettii Archer & Elix sp. nov. Fig. 1

Thallus flavido-albus, areolatus et rimosus, superficies laevis et hebetata, isidiis et sorediis destitutis; corticola; apothecia verruciformia, inconspicua, numerosa, flavida, saepe confluentia, perplano-hemisphaerica vel immersescia, 1-2 mm diam., ostiola conspicua, nigra, circularia vel irregularia, 0.2-0.6 mm latae, in verrucas 1-3na; sporae 8nae, biseriatae, ellipsoideae, laeves, 60-75 μm longae, 25-32 μm latae.
Thallus arthothelin, acidum thiophanicum et 2,4-dichloronorlichexanthone continens.

Type: New Zealand, North Island, Mangonui County, Herekino Gorge, 35°10'S, 173°12' E, alt. 400 ft. [*ca.*120 m], on bark of *Rhopalostylus sapida* on exposed hillside, *J.K. Bartlett s.n.*, 26.x.1981; AK 192225-holotype.

Thallus pale yellowish white, areolate and cracked, surface smooth and dull, lacking isidia and soredia, corticolous; *apothecia* verruciform, inconspicuous, numerous, pale yellow, sometimes confluent, very flattened-hemispherical or becoming immersed, 1-2 mm diam.; ostioles conspicuous, black, circular or irregular in outline, 0.2-0.6 mm wide, 1-3 per verruca; *spores* 8 per ascus, biseriate, ellipsoid to subfusiform, smooth, 60-75 μm long, 25-32 μm wide.

Chemistry: K-, KC+ orange red, C+ orange, Pd-; arthothelin (major), thiophanic acid (major), 2,4-dichloronorlichexanthone (major); 2,5-dichloronorlichexanthone (minor) and 4,5-dichloronorlichexanthone (trace), 2-chloronorlichexanthone (trace), 4-chlorolichexanthone (trace) and thiophaninic acid (trace).

Pertusaria bartlettii is characterised by pale yellow, flattened or immersed verrucae with conspicuous black ostioles and the presence of polychlorinated norlichexanthones; these features distinguish the new species from all other New Zealand *Pertusaria*.
The new species is known only from the type specimen; the epithet "bartlettii" refers to John K. Bartlett, 1945 -1986, an enthusiastic collector of lichens in New Zealand.

Pertusaria celata Archer & Elix sp. nov. Fig. 2

Thallus albidus vel cinereo-albidus, tenuis, rimosus, superficies laevis et nitidae, isidiis et sorediis destitutis; corticola; apothecia verruciformia, conspicua, sparsa, plano-hemisphaerica, thallo concoloria, basibus non constrictis, lacerescentia, epithecia fusca vel nigra manifestescentia; sporae 8nae, biseriatae, ellipsoideae vel subfusiformes, laeves, 90-100(-120) μm longae, 30-40(-50) μm latae, parietibus exterioribus 2-4 μm crassis, parietibus interioribus 4-5 μm crassis.
Thallus acida salazinicum, norsticticum et connorsticticum continens.

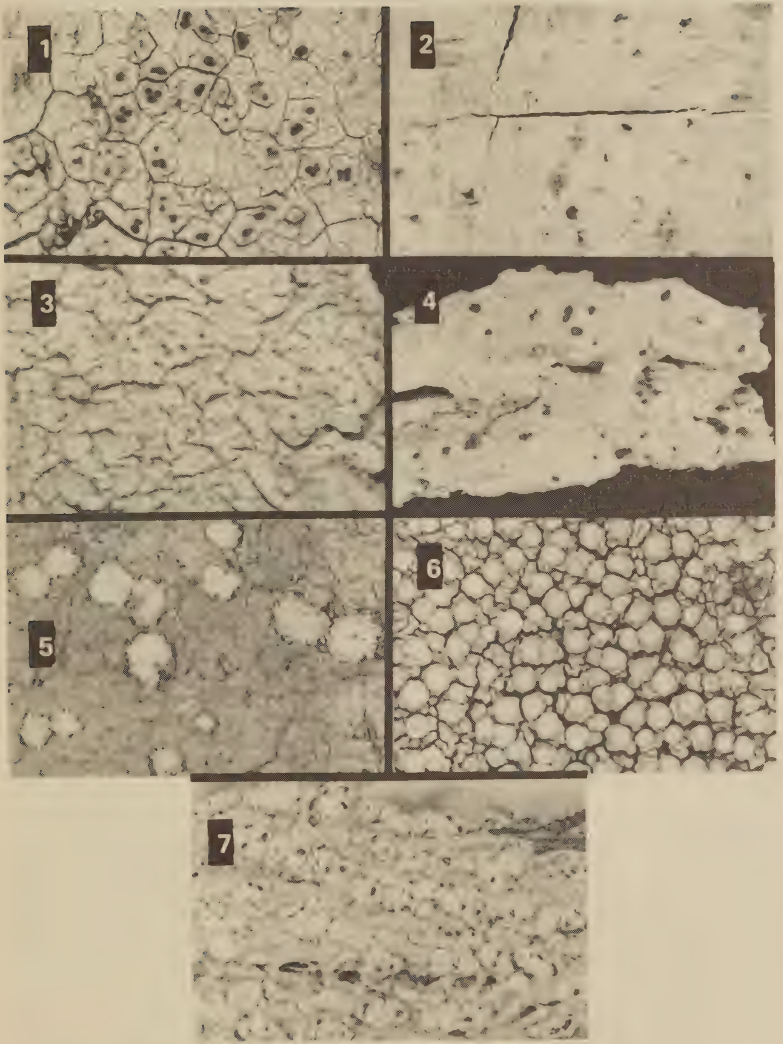
Type: New Zealand, North Island, South Auckland, Matamata County, Mamaku Plateau, Tirau-Matamata Road, 38°09'S, 176°E, alt. 1200 ft [*ca.* 360 m], on *Weinmannia racemosa* bark, *J.K. Bartlett 19749*, 28.iii.1982; AK 192245-holotype.

Thallus off-white to pale grey, thin, cracked, surface smooth and shiny, lacking isidia and soredia, corticolous; *apothecia* verruciform, conspicuous, sparse, flattened-hemispherical, concolorous with the thallus, not constricted at the base, 1-1.5 mm diam., becoming split and torn to reveal the dark brown to black epithecium; *spores* 8 per ascus, biseriate, ellipsoid to subfusiform, smooth, 90-100(-120) μm long, 30-40(-50) μm wide, outer wall 2-4 μm thick, inner wall 4-5 μm thick.
Chemistry: K+ yellow becoming red, KC-, C-, Pd+ yellow; salazinic acid (major), norstictic acid (minor) and connorstictic acid (trace).

Specimens examined:
New Zealand, North Island, type locality, , *J.K. Bartlett 19739*, 28.iii.1982 (AK 192244), *J.K. Bartlett 19736*, 28.iii.1982(AK 192246).

South Island, Nelson, Mt. Duppa Track, 41°12'S, 173°29'E, alt. *ca.* 750 m, *W. Malcolm 855*, 3.v.1993 (CHR 470255).

Pertusaria celata is characterised by the torn verrucae, revealing the epithecium of the apothecia below and in this respect it somewhat resembles the saxicolous New Zealand



Figs 1-7. New Pertusaria species. 1. *Pertusaria bartlettii*, x3; 2. *Pertusaria celata*, x3; 3. *Pertusaria hadrospora*, x4; 4. *Pertusaria parvula*, x3.75; 5. *Pertusaria psoromica*, x3; 6. *Pertusaria scutellifera*, x3; 7. *Pertusaria sporellula*, x4.

P. erumpescens Nyl.; the spores in this species are 30-40 μm long. Although unlike many verruciform *Pertusaria* taxa, the new taxon has spores with the double wall characteristic of the genus. *P. celata* is known from both the North and South Islands. The epithet "celata" hidden, refers to the concealed epithecium and asci.

Pertusaria hadrospora Archer & Elix sp. nov. Fig. 3

Thallus dilute olivaceus, crassus, subrimosus, superficies laevis et nitidae, isidiis et sorediis destitutis; corticola; apothecia verruciformia, inconspicua, saepe solum ostiolis indicata, perplano-hemisphaerica vel immersa, thallo concoloria, 0.6-1 mm diam.; ostiola inconspicua, subtranslucida, in verrucas 1-2na, 0.2-0.4 mm diam.; sporae 2nae, raro 3, ellipsoideae, laeves, 210-250(-300) μm longae, 50-75 μm latae.
Materia chemica in thallo non detecta.
Type: New Zealand, South Island, Golden Bay County, northwest Nelson, Kaihoka Lakes, 40°31'S, 172°36'E, sea-level, *J.K. Bartlett 22268*, 13.xii.1982; AK 192257-holotype.

Thallus pale olive green, thick, somewhat cracked, surface smooth and shiny, lacking isidia and soredia, corticolous; *apothecia* verruciform, inconspicuous, often only indicated by the ostiole, very flattened-hemispherical or immersed, concolorous with the thallus, 0.6-1 mm diam.; ostioles inconspicuous, grey, translucent, 1or 2 per verruca, 0.2-0.4 mm diam.; *spores* 2 per ascus, rarely 3, ellipsoid, smooth, 210-250(-300) μm long, 50-75 μm wide.

Chemistry: K-, KC-, C-, Pd-; no lichen compounds detected by tlc or hplc.

Specimen examined:
New Zealand, South Island, Golden Bay County, northwest Nelson, Tasman Mountains, Lake Cobb, 41°02'S, 172°31'E, alt. *ca* 3000 ft.[900 m], *J.K. Bartlett 21528*, 14.xii.1982 (AK 192258); Arthur Range, Lodestone track, 41°10.7'S, 172°44.6'E, alt. 1170 m, *W. Malcolm 992*, 18.vii.1993 (herb. Malcolm).

Pertusaria hadrospora is characterised by the inconspicuous verrucae and asci with two (rarely three) large spores; these features distinguish the new species from all other corticolous New Zealand *Pertusaria*.
Zahlbruckner (1941: 334) reported a corticolous, two-spored *Pertusaria*, *P.tetrathalamia* var. *major* [*P. leucoplacoides* var. *major* Müll.Arg. (Müller 1884: 301)] to occur in New Zealand but the specimen on which this report was based (CHR 452614) is identified as *P. sorodes* Stirton. The spores in the specimen are 225-260 μm long and 55-70 μm wide, with rough inner spore walls, whereas Müller reported the spores in his var. *major* to be 150-210 μm long and 30-40 μm wide (Müller, loc. cit.). This specimen is morphologically and chemically distinct from *P. hadrospora*.
The epithet "hadrospora", well-devloped spores, refers to the large spores present in the asci of the new species.

Pertusaria parvula Archer & Elix sp. nov. Fig. 4

Thallus albidus, tenuis, subrimosus, superficies subnitida, isidiis et sorediis destitutus; corticola; apothecia verruciformia, perplano-hemisphaerica, thallo concoloria, dispersa, 0.8-1.2 mm diam.; ostiola conspicua, nigra, 0.2-0.3 mm diam., in verrucas singula; sporae 8nae, uniseriatae, ellipsoideae, laeves, 30-37 μm longae, 18-20 μm latae.
Thallus 4,5-dichlorolichexanthone solum continens.

Type: New Zealand, South Island, Sounds-Wellington Ecological Region, Cook Strait Ecological District, Chetwode Islands, Nukuwaitata Island, 40°54'S, 174°04'E, on bark, *B. Hayward, s.n.*, Mar. 1984; AK 206954-holotype.

Thallus off-white, thin, somewhat cracked, surface smooth and somewhat shiny, lacking isidia and soredia; corticolous; *apothecia* verruciform, very flattened hemispherical, concolorous with the thallus, scattered, 0.8-1.2 mm diam.; ostioles conspicuous, black, 0.2-0.3 mm diam., 1 per verruca; *spores* 8 per ascus, uniseriate, ellipsoid, smooth, 30-37 μm long, 18-20 μm wide.

Chemistry: K-, KC-, C-, Pd-; 4,5-dichlorolichexanthone only.

Pertusaria parvula is characterised by verruciform apothecia, small spores and the presence of 4,5-dichlorolichexanthone. Externally it resembles both *P. melaleucoides* Müll.Arg. and *P. albissima* Müll.Arg. but is distinguished from those species by the number and size of spores, and the presence of the chlorinated xanthone. The new species is known only from the type specimen.
The epithet "parvula" (smallest) refers to the small spores characteristic of the new species.

Pertusaria psoromica Archer & Elix sp. nov. Fig. 5

Thallus hinnuleus vel dilute olivaceus, areolatus et rimosus, superficies laevis vel subtuberculata, subnitida, isidiis destitutis sed sorediatus; corticola; soralia conspicua, numerosa, alba, hemisphaerica vel disciformia, 0.5-2 mm diam.; apothecia non visa. Thallus acidum psoromicum continens.
Type: New Zealand, North Island, Otamatea County, Kaiwaka, 36°09'S, 174°27'E, *J.K. Bartlett 24219*, 1975-1985, AK192231-holotype.

Thallus dull fawn or pale olive green, areolate and cracked, surface smooth or subtubercular, somewhat shiny, lacking isidia, sorediate, corticolous; *soralia* conspicuous, numerous, white, initially pustulate, composed of granular soredia, hemispherical or discoid, 0.5-2 mm diam.; *apothecia* not seen.

Chemistry: K-, KC+ yellow, C+ yellow, Pd+ strong yellow; psoromic acid (major) and conpsoromic acid (minor).

Specimens examined:
AUSTRALIA, Queensland, Mt. Baldy, 4 km SW of Atherton, 17°17'S, 145°27'E, alt. 1080 m, on *Alphitonia* in rain forest, *J.A.Elix 16276*, 25.vi.1984 (ANUC); Mount Windsor Tableland, 45 km NW of Mossman, 16°15'S, 145°01'E, alt. 1200 m, on *Syzygium* in rain forest, *J.A.Elix 16445, 16449*, 26.vi.1984 (ANUC).
New South Wales, Wiangaree Forest Drive, Tweed Range, "Antarctic Beech Walk", on *Nothofagus moorei* in rain forest, *G. Kantvilas 645/88*, 3.viii.1988 (HO, NSW 219573); Border Ranges National Park, Bar Mountain Lookout track, 28°28'S, 153°06'E, alt. ca. 950 m, on fallen branch, *A.W. Archer P 480*, 7.ix.1992 (NSW).

NEW ZEALAND [15 out of 39], North Island, Great Barrier Island, Mount Hobson, 36°11'S, 172°25'E, alt. *ca.* 500 m, *B.Hayward s.n.*, Jan. 1983 (AK 182649); ibid., Jan. 1984 (AK 171774); Rakitu Island, 36°08'S, 175°30'E, *B.Hayward s.n.*, 1980 (AK162392); *ibid.* (AK 160765); Coromandel County, Mount Moehau, 36°32'S, 175°24'E,alt. *ca.* 700 m, *B. Hayward H39.65*, Aug. 1974 (AK154517); Thames County, Upper Kauaeranga Gorge, 37°04'S, 175°40'E, alt. *ca.* 350 m, *J.K.Bartlett s.n.*, 1975-1985 (AK192243); Rimutaka State Forest Park, 41°21'S, 174°58'E, alt. 300 m, on *Pseudowintera colorata* in *Kunzea ericioides* forest, *B. Polly s.n.*, 1.vi.1993 (WELT).

South Island, Dunedin, Mt. Cargill, *ca.* 300 m, on bark of *Aristotelia*, *W.Martin s.n.*, 9.xii.1953 (OTA 880); Westland, between Greymouth and Runanga, on *Nothofagus*, *W. Martin s.n.*, 4.iii.1954 (OTA 1285); Otago, Silver Peaks near Dunedin, on beech, *J. Thomson 1229* (CHR361434); West Otago, Eglington Valley, Cascade Creek, on *Nothofagus menziesii*, alt. *ca.* 450 m, *W.Martin s.n.*, 27.ii.1972 (CHR479324 pp); Golden Bay, Kaihoka, 40°33'S, 172°35'E, *J.K.Bartlett s.n.* (AK192253, AK192254); Stewart Island, Port Pegasus, Islet Cove, 47°12'S, 167°38'E, alt. 10 m, *B.Hayward s.n.*, 3.ii.1989 (AK208187); D'Urville Island, Mount Maud, 40°53'S, 173°49'E, alt. ca. 500 m, *B.Hayward s.n.*, 4.i.1988 (AK206939).

Pertusaria psoromica is characterised by the presence of numerous, conspicuous white soralia, reacting K- and Pd+strong yellow due to the presence of psoromic acid. The soredia of *P. psoromica* also give a yellow colour with KC and C; this colour is produced by reaction with psoromic or conpsoromic acids as thin layer chromatography showed only these two compounds to be present. The podetia of *Cladonia subpityrea* Sandst. (which also contain the same two lichen acids) give no colour with KC and C but if acetone extracts from both species are spotted onto filter paper and treated with KC or C, a yellow colour is given by both extracts.The new species occurs at all altitudes from sea-level to *ca.* 700 m in New Zealand and up to 1200 m in Australia. In New Zealand it has been found on *Coprosma arborea*, *Nothofagus menziesii*, *Olearia furfuracea*, *O. rani*, and on the bark of *Rhopalostylis sapida*, *Metrosideros excelsa* and *Dysoxylum spectabile*. The new species resembles, in morphology and wide distribution, the sterile, sorediate Australian *P. scaberula* Archer (Archer 1991:240) but is distinguished from that species (which contains lichexanthone and thamnolic acid) by the negative reaction with alkali. *Pertusaria scaberula* is common in eastern Australia whereas *P. psoromica* occurs in both the North and South Islands of New Zealand, and to a more limited extent in Australia, in Queensland and New South Wales.

The new species is chemically similar to *P. sphaerulifera* Vainio (Vainio 1907) from Thailand but that species is saxicolous, and pustulate rather than sorediate.

Pertusaria scutellifera Archer & Elix sp. nov. Fig. 6

Thallus albidus, areolatus et rimosus, superficies irregulariter subtuberculata et hebetata, isidiis et sorediis destitutis; corticola; apothecia disciformia, conspicua, numerosa, thallo concoloria, 0.6-1.2 mm diam.; disci auranto-fusci et confertim albo-pruinosi; sporae singulae, ellipsoideae, laeves, (125-)150-185 μm longae, 45-55 μm latae, parietibus 3-5 μm crassis
Thallus acidicum thamnolicum continens.
Type: New Zealand, North Island, Mt. Ruapehu, *W.H.Ewers 2657*, 31.iii.1988; AK 200760-holotype.

Thallus off-white, areolate and cracked, surface irregularly subtuberculate and dull, lacking isidia and soredia; corticlous; *apothecia* disciform, conspicuous, numerous and crowded, concolorous with the thallus, 0.6-1.2 mm diam.; disc orange-brown, densely white-pruinose; *spores* 1 per ascus, ellipsoid, smooth, (125-)150-185 μm long, 45-55 μm wide; spore wall single, 3-5 μm thick.

Chemistry: K+ yellow, KC-, C-, Pd+ yellow; thamnolic acid.

Specimens examined:
New Zealand, North Island, Mt. Ruapehu, *W.H.Ewers 2626 p.p.*, 2627, 31.iii.1988 (CBG); Rangitaiki, *W.H.Ewers 2861*, 28.iii.1988 (CBG).
South Island, Arthurs Pass, on *Nothofagus cliffortioides*, *H.H.Allan s.n.* (CHR 361433); West Otago, Eglington Valley, Cascade Creek, *W. Martin A552*, 14.iii.1964 (CHR479323); Nelson, Mt. Arthur, 41°12'S, 172°44'E, 1170 m, on *Dracophyllum traversii* bark in montane low forest, *P.N. Johnson 417*, 29.i.1993 (CHR 480406);

Nelson, Mt. Arthur, Flora Hut, start of track, 41°11'S, 172°43'E, alt. 940 m, on fallen branch, *W. Malcolm 873*, 13.v.1993 (CHR 470257).

Pertusaria scutellifera is characterised by disciform apothecia, single spored asci and the presence of thamnolic acid. It is morphologically similar to *P.novaezelandiae* Szatala but is distinguished from that species by the yellow colour given with alkali, in contrast to the violet colour given by *P. novaezelandiae* which contains hypothamnolic acid. The new species also resembles the Japanese *P. sphaerophora* Oshio (Oshio 1968) but is distinguised from that species by differences in chemistry and spore morphology. Oshio (loc.cit.) reported that with alkali (K) his new species gave a yellow colour becoming violet and Dibben (1980) found thamnolic acid and an unidentified compound present in the Japanese species. The two species also differ in spore wall thickness; the spore walls are 13-21 μm thick in *P. sphaerophora* and 3-5 μm thick in *P. scutellifera*. The new species is differentiated from the Japanese *P. nigrodisca* Oshio (Oshio 1968) [which also contains thamnolic acid and one-spored asci] by the colour of the discs, black in *P. nirodisca* and orange brown in *P.scutellifera.*
Zahlbruckner identified (in sched.) the specimen CHR 361433 as *P. globulifera* subsp. *glaucomopsis* Nyl. [*P. globulifera *glaucomopsis* Nyl. tax. vag. (Nylander 1888: 67)] but the relevant specimens in the Nylander Herbarium [H-NYL 23765, 23766, 23767, 23768] lacked thamnolic acid and this taxon is thus distinct from *P. scutellifera*. *Pertusaria globulifera *glaucomopsis* was reported by Nylander (loc.cit.) to be K -ve.
The epithet "scutellifera", bearing little dishes, refers to the numerous conspicuous disciform apothecia.

Pertusaria sporellula Archer & Elix sp. nov. Fig. 7

Thallus albidus vel cinereo-albidus, tenuis, superficies laevis et subnitida, isidiis et sorediis destitutis; corticola; apothecia disciformia, numerosa,dispersa, saepe contigua, marginibus incrassatis, initio involutis, thallo concoloribus; disci nigri, albo-pruinosi, concavi complanatescentes, 0.2-0.4 mm diam.; sporae 8nae, uniseriatae, sphaericae, 15-20 μm diam., parietibus ca. 1 μm crassis.
Materia chemica in thallo non detecta.
Type: New Zealand, North Island, Kaipera Ecological Region & District, North Kaipera Barrier, Tapu Bush, 36°19'S, 174°04'E, alt. 110 m, *A.E.Wright 11561*, 25.v.1991; AK 202378-holotype.

Thallus off-white to pale greyish white,thin, surface smooth and somewhat shiny, lacking isidia and soredia; corticolous; *apothecia* disciform, numerous, scattered or sometimes contiguous, margins thick, initially inrolled, concolorous with the thallus, discs black, partly white-pruinose, initially concave, becoming flat, 0.2-0.4 mm diam.; *spores* 8 per ascus, uniseriate, spherical, 15-20 μm diam., spore wall thin, ca. 1 μm thick.

Chemistry: K-, KC-, C-, Pd-; no lichen compounds detected.

Pertusaria sporellula is characterised by disciform apothecia, eight-spored asci with very small spherical spores and the absence of lichen compounds. It somewhat resembles *P. truncata* Krempelh. but is readily differentiated from that taxon by the negative reaction with alkaline hypochlorite (KC), in contrast to the characteristic violet colour given by *P.truncata.*
The epithet "sporellula", very small spores, refers to the small spherical spores in the new species.

NEW REPORTS

Pertusaria albissima Müll.Arg. *Flora* 67: 350 (1884)

Type: New Zealand, sin. loc., *C. Knight s.n.*, "*Pertusaria leucodeoides* Knight" nom. nud.; G-lectotype [here selected]; *C. Knight s.n.*, "*Pertusaria leucodes* var. *inconspicua* Knight" nom. nud.; G residual syntype.

Thallus chalky white, slightly areolate and cracked, surface smooth and dull, lacking isidia and soredia, corticolous; *apothecia* verruciform, concolorous with the thallus, conspicuous, numerous, sometimes confluent, flattened-hemispherical, sometimes constricted at the base, 1-2 mm diam.; ostioles inconspicuous, pale, translucent, 2-4 per verruca; *spores* 8 per ascus, uniseriate, ellipsoid, smooth, 50-62 μm long, 23-28 μm wide.
Chemistry: K-, KC-, C-, Pd-; no lichen compounds detected by hplc.

Müller described three species from different parts of Knight's specimen of "*Pertusaria leucodeoides* Knight" [nom. nud. in sched.] (two of which are here reported to be synonyms) as shown in Table 1.

Galloway (1985) reported *P. albissima* to be synonymous with *P. cretacea* Müll.Arg. but the two species are distinguished by the difference in spore arrangement and the colour of the ostioles (black in *P. cretacea* , syn. *P. leucodes* Knight) as originally noted by Müller (1884, loc.cit.) and the two species are here retained as separate entities. *Pertusaria laevis* Knight is distinguished from *P. albissima* by the black ostioles and the presence of thiophaninic acid, which was detected in the holotype (WELT) by liquid chromatography. *Pertusaria albissima* is known only from Knight's two specimens.

The protologue to *P. albissima* refers to two syntypes collected by Charles Knight; one of these, labelled "*P. leucodeoides* Knight" by Knight, is also labelled "*P. albissima* Müll.Arg. L.B.n. 749", a reference to the publication Lichenologische Beiträge XIX, number 749 (Müller, 1884) and this specimen is here selected as lectotype.

TABLE 1

NEW SPECIES FROM "PERTUSARIA LEUCODEOIDES KNIGHT"

Original Herbarium name	Published Name	spore arrangement	spore length μm	Chemistry
P. leucodeoides Knight	*P. leucodeoides* Müll.Arg.	2-seriate	90-113	xanthone(a)
	[syn. *P. theochroa* Kremplh.	2-seriate	87-113	thiophaninic acid (b)]
"	*P. cretacea* Müll.Arg.	2-seriate	50-70	nil (a)
	[syn. *P. leucodes* Knight	2-seriate	55-70	nil (b)]
"	*P. albissima* Müll.Arg.	1-seriate	50-62	nil (b)
P. leucodes var. *inconspicua* Knight	"	1-seriate	48-55	nil (b)

(a) reported by Galloway, op. cit. (b) determined by Archer & Elix

Both *P. leucodeoides* Müll.Arg. and *P. theochroa* Krempelh. (Krempelhuber 1876: 452) have verrucae with black ostioles and asci with 8 biseriate spores that are 90-113 μm long. Galloway (Galloway 1985: 375,380) reported the chemistry of the two taxa to be identical; the holotype of *P. theochroa* (M) contains thiophaninic acid. As the two species are morphologically and chemically identical, the two species are considered to be conspecific, as was originally suggested by Galloway (Galloway, loc. cit.).

In addition, both *P. cretacea* Müll.Arg. and *P. leucodes* Knight have abundantly fertile thalli with numerous verrucae, the verrucae with inconspicuous ostioles and the asci with 8 biseriate spores that are 50-70 μm long. *Pertusaria leucodes* was reported to contain stictic acid (Galloway 1985: 376) but an examination of the lectotype from WELT found no lichen compounds present. In view of these morphological and chemical similarities, the two species are considered to be identical, as was originally proposed by Dibben (Dibben 1984, in sched.).

Pertusaria alboatra Zahlbr. *Denkschr. Akad. Wiss. Wien math.-naturwiss. Kl.* 104:336 (1941).

Type: New Zealand, North Island, Rangitoto Island, Auckland, on trunk of *Avicennia officianalis* in salt lagoon, *H.H.Allen 46*, Aug.1933; W-lectotype [fide D.J. Galloway 26.xi.1981, in sched.]; CHR 374706-iso-lectotype; ibid., on *Avicennia resinifera*, *H.H. Allen W93*, 12.iv.1936; CHR 361450, W-residual syntypes.

Thallus pale yellowish fawn, conspicuously areolate and cracked, surface smooth and dull, lacking isidia and soredia, corticolous; apothecia verruciform, numerous, conspicuous, often confluent, flattened-hemispherical to immersed, 0.5-1 mm diam.; ostioles conspicuous, black, one per verruca, 0.1-0.4 mm diam., sometimes with a pale grey translucent margin; spores 2 per ascus, rarely 3, ellipsoid, smooth, (70-)85-110(-132) μm long, 35-45 μm wide.

Chemistry: K-, KC+ weak yellow, C-, Pd-; thiophaninic acid (major) with 2-chloro-6-*O*-methylnorlichexanthone (trace) and 4-chloro-6-*O*-methylnorlichexanthone (trace).

Specimens examined:
NEW ZEALAND, North Island, Mangonui County, Waitiki Stream, 34°30'S, 172°50'E, *J.K. Bartlett s.n.*, 1975-1985 (AK 194384); North Island, Paihia, on mangroves, *W. H. Ewers 2743*, 6.iv.1988 (CBG); Sounds-Wellington Ecological Region, Sounds Ecological District, Resolution Bay, E end of Bay E of wharf, 41°07'S, 174°13'E, alt. 1-5 m, on bark of karaka and mahoe, *B.W. Hayward s.n.*, 6.i.1992 (AK 205603).

Pertusaria alboatra was not included in the Flora of New Zealand Lichens (Galloway 1985) and a description has therefore been given here. The species resembles *P. melaleucoides* Müll.Arg. but is distinguished from that species by the presence of thiophaninic acid and the occasional occurrence of three-spored asci. Zahlbruckner labelled two specimens, CHR 374706 and AK 18997, "*Pertusaria atroalba* (sic) sp. nov." The specimen in CHR is numbered "46" and was collected by W.H.Allen on 24.viii.1933 from *Avicennia officinalis* and contains thiophaninic acid; it is thus identical to the specimen in W. The specimen in AK was collected at the same location on the same day but from *A. resinifera*; it has no number and contains no lichen compounds and is identified as *P. melaleucoides* Müll.Arg. (Archer & Elix 1993a).

Pertusaria leucoplaca Müll.Arg. *Flora* 67: 304 (1884).

Type: Brazil, Apiahy, on *Araucaria*, *Puiggari 2128*, Oct. 1882; holo: G.

Pertusaria acuta Müll.Arg. *Flora* 67: 353 (1884).

Type: India, in montibus Neilgherries [Nilgiri Hills, *ca.* 250 km SSW of Bangalore], on *Cinchona succirubris*, *Bader s.n.*; holo: G.

Thallus greyish-white, areolate and cracked, surface smooth and dull, lacking isidia and soredia, corticolous; apothecia verruciform, conspicuous, scattered, flattened hemispherical, sometimes constricted at the base, concolorous with the thallus, sometimes slightly concave above, 0.8-1.5 mm diam.; ostioles conspicuous, pale brown to dark brown to black, 1, rarely 2, per verruca; spores 8 per ascus, biseriate or irregularly biseriate, subfusiform to fusiform, smooth, 70-90, rarely to100 μm long, 25-35 μm wide.
Chemistry: K-, KC-, C-, Pd-; 2-*O*-methylstenosporic acid with 2-*O*-methylperlatolic and 2-*O*-methyldivaricatic acid as minor or trace compounds.

Specimens examined:
AUSTRALIA, New South Wales, Upper Kangeroo River Rd, 9 km S of Robertson, *H. Streimann 35796* (B, CBG); Olney State Forest, *ca.* 25 km W of Morisset, *A. Archer P 166*, 21.vi.1991 (NSW); Mt. Ebsworth Rd, 4 km SW of Stroud, *A. Archer P194*, 31.iii.1992 (NSW); Murramarang N.P. *ca.* 10 km N of Batemans Bay, *A. Archer P301* (NSW). Victoria, Laughton Gully, Mar 1889, *F. Wilson* (NSW).

NEW ZEALAND, North Island, Great Barrier Island, Rakitu (Arid) Island, 36°08'S, 175°30'E, *B.Hayward s.n.*, Jan.1981 (AK169175); Poor Knights Island, Aorangi, E of Oneho Hill, 35°30'S, 174°33'E, alt. 180 m, *B.Hayward s.n.*, Aug.1984 (AK172444).

P. leucoplaca resembles the Australian species *P. leucostigma* Müll.Arg. (with which it often occurs in Australia) but is distinguished from that species by the absence of lichexanthone,the darker ostioles and the slightly smaller biseriate spores. *Pertusaria leucoplaca* is characterised by the eight biseriate spores and the presence of 2-*O*-methylstenosporic acid. It occurs in Australia, New Zealand, Brazil and India.

Pertusaria schizostomella Müll.Arg. *Bull. Herb. Boissier* 3: 637 (1895).

Type: Australia, New South Wales, *C. Knight 31*, 1887; G-holotype.

Thallus pale yellowish green to pale greyish green, slightly or coarsely areolate and cracked, surface smooth or very slightly rough, dull, lacking isidia and soredia, corticolous; apothecia verruciform, conspicuous, scattered or crowded and becoming confluent, concolorous with the thallus, slightly flattened-hemispherical, not constricted at the base, 0.5-1 mm diam.; ostioles conspicuous, pale, translucent, dull yellow, usually one per verruca; spores 2 per ascus, ellipsoid, smooth, or very slightly rough, 80-125 μm long, 30-45 μm wide.

Chemistry: K-, KC+ orange, C+ orange, Pd-; thiophaninic acid (major), stictic acid (major) with constictic acid (minor -trace).

Specimens examined:
AUSTRALIA, Queensland, Turkey, on *Rhizophora*, *N. Stevens 1241*, 18.viii.1975 (BRI); Brisbane area, Deception Bay, on mangrove, *H.T. Lumbsch 5381g*, 10.viii.1987 (herb. Lumbsch). New South Wales, Lord Howe Island, Valley of Shadows, 31°31'45"S, 159°04'45"E, alt. 40m, *J.A. Elix 32840, 32841*, 22.vi.1992 (ANUC); Newport, on mangroves, *F.R.M. Wilson s.n.*, Oct 1888, (NSW L4499); Batemans Bay, 35°44'S, 150°13'E, sea-level, on *Avicennia*, *H. Streimann 37917*, 20.i.1987 (CBG 9201737).

NORFOLK ISLAND, Ball Bay Reserve, 29°32'S, 167°59'E, alt. 80 m, on *Araucaria* trunk, *H. Streimann 31726*, 1.xii.1984 (CBG 9201715); Philip Island, Upper Long Valley, 29°07'30"S, 167°57'E, alt. 80 m, on roots of *Lagunaria*, *H. Streimann 32202*, 4.xii.1984 (CBG 9215716); ibid., *H. Streimann 32217*, 4.xii.1984, (CBG 9201717).

NEW ZEALAND, North Island, Rangitoto Island, near Islington Bay, on *Avicennia resinifera*, *H.H. Allan s.n.*, 24.viii.1933 (AK 18993); ibid., 12.iv.1936 (CHR 413815); ibid., on *Avicennia officinalis*, *H.H.Allan s.n.*, 24.viii.1932 (CHR 452611, CHR 452613); near Slipper island, Watchman Rock, 37°03'S, 175°55'E, *B.Hayward 126*, Aug. 1973 (AK 171693); Coromandel County, Great Mercury Island, 36°36'S, 175°48'E, *B. Hayward H40.48*, May 1975 (AK 187603); Tairua Ecological District, Slipper Island, 37°03'S, 175°56'E, *B. Hayward H49.170* , *H49.204*, Aug. 1973 (AK 206948, AK 155028); Tapotupotu Bay, 34°36'S, 172°43'E, on mangroves, *B. Hayward s.n.*, May 1984 (AK 206952).

Pertusaria schizostomella is characterised by its two-spored asci, conspicuous translucent ostioles and the presence of thiophaninic and stictic acids. It occurs in eastern coastal Queensland and New South Wales, Norfolk Island, Lord Howe Island and in the North Island of New Zealand, often on mangroves at sea-level.

The earliest New Zealand specimens, AK 18993, CHR 413815, CHR 452611 and CHR 452613, were originally identified by Zahlbruckner as *P. melaleuca* var. *heterochroa* (Müll.Arg.) Stirton (Zahlbruckner 1941: 329) but the specimens correspond in all respects to *P. schizostomella*.

Pertusaria subisidiosa Archer, *Mycotaxon* 41: 242 (1991).

Type: Australia, Queensland, North Stradbroke Island, NE of Brown Lake, 27°29'S, 153°26'E, on fallen trunk in mixed rain forest, *J. Hafellner 19204*, 10.viii.1986; GZU-holotype.

Thallus pale cream-white,thin, continuous, surface smooth and dull, isidiate, lacking soredia,; corticolous; isidia simple, concolorous with the thallus, profuse, 0.1-0.3 mm tall, 0.05-0.1 mm diam.; apothecia verruciform, concolorous with the thallus, inconspicuous, scattered, flattened-hemispherical, isidiate, 0.5-0.7 mm diam.; ostioles black, conspicuous, 0.1-0.2 mm diam., 1 per verruca; spores 4 per ascus, uniseriate, ellipsoid, rough, 80-95 μm long, 25-35 μm wide.

Chemistry: K-, KC-, C-, Pd-; 2,5-dichlorolichexanthone (major), 2,4,5-trichlorolichexanthone (major), 2-chlorolichexanthone (minor), 2,4-dichlorolichexanthone (minor to trace) and stictic acid (major).

Specimens examined:
AUSTRALIA, New South Wales, Minnie Water Beach, ca. 40 km ESE of Grafton, 29°47'S, 153°18'E, alt. *ca.* 10 m, on *Banksia* behind beach, *A.W.Archer P 382*, 13.ix.1992 (NSW).

NEW ZEALAND, North Island, Three Kings Islands, Great Island, Castanay Valley, on kanuka, *D.J.Galloway s.n.*, Nov. 1970 (CHR 451403 pp).

Pertusaria subisidiosa is characterised by the isidiate thallus, the asci with four rough spores, the conspicuous black ostoles and its chemistry. *Pertusaria subisidiosa* was originally reported to contain stictic acid and traces of 4,5-dichlorolichexanthone (Archer 1991:242) but liquid chromatography showed the presence of the chloroxanthones listed above. *Pertusaria subisidiosa* resembles the Northern Hemisphere species *P. coronata* (Ach.) Th.Fr. but is chemically distinct from that species; *P. coronata* contains 4,5-dichlorolichexanthone and stictic acid.

Pertusaria subplanaica Archer & Elix, *Mycotaxon* 45: 422 (1992).

Type: Australia, New South Wales, Patterson River [near junction with Hunter River, *ca.* 10 km E of Maitland, 32°44'S, 151°33'E], *J. L. Boorman s.n.*, Aug 1906; NSW-holotype.

Thallus pale olive green somewhat cracked, surface smooth and dull, lacking isidia and soredia, corticolous; apothecia verruciform, conspicuous, dispersed, sometimes confluent, concolorous with the thallus, flattened-hemispherical, constricted at the base, 0.8-1.5 mm diam.; ostioles inconspicuous, brown, 1 per verruca; spores 8 per ascus, irregularly uniseriate, smooth, ellipsoid becoming fusiform, (60-)80-100(-120) μm long, 30-40 μm wide.

Chemistry: K-, KC-, C-, Pd-; 4,5-dichlorolichexanthone and 2,2'-di-*O*-methylstenosporic acid, with traces of planaic acid and 2,2'di-*O*-methyldivaricatic acid.

Specimens examined:
AUSTRALIA, Queensland, Mt. Mee State Forest, *J. Hafellner 16887*, 13.viii.1986 (GZU); Gambubal State Forest, E of Emu Mtn, *J. Hafellner 16339*, 7.ix.1986 (GZU).N.S.W.: Blue Mountains N.P., Mt. Wilson, *K. Kalb 20468*, 31.vii.1988 (herb. KALB); Royal N.P., Bola Creek, *K. Kalb 21690, 21700*, 2.viii.1988 (herb. KALB).

NEW ZEALAND, North Island, Auckland City, Rangitoto Island, *J.Wadham s.n.*, 19.i.1951 (AK172648); Thames County, *B.Hayward s.n.*, Aug.1973 (AK154526); Coromandel County, Mt. Mangatawhiri, 36°47'S, 175°46'E, *B.Hayward s.n.*, Aug.1974 (AK171724).

Pertusaria subplanaica is characterised by asci with eight spores and the presence of 2,2'di-*O*-methylstenosporic acid. It occurs in eastern Australia and the North Island of New Zealand.

Pertusaria thamnolica Archer, *Mycotaxon* 44:16 (1992)

Type: Australia, New South Wales, E side of Mooney Mooney Creek, *ca.* 8 km WSW of Gosford, 33°26'S, 151°15'E, alt. ca. 10 m, on *Casuarina*, *A.W. Archer P 178*, 24.v.1991; NSW-holotype; ANUC-isotype.

Thallus off-white to pale grey, areolate and cracked, surface smooth and dull, lacking isidia and soredia, corticolous; *apothecia* disciform, conspicuous,scattered, 0.5-1.5 mm diam., with thick inrolled margins, surface of disc white-pruinose; *spores* 8 per ascus, uniseriate, ellipsoid, smooth, 22-32 μm long, 12-17 μm wide, spore wall single, ca. 1 μm thick.

Chemistry: K+ yellow, KC-, C-, Pd+ yellow; thamnolic acid.

Specimens examined:
AUSTRALIA, New South Wales, Buckenbowra River Estuary, 7.5 km W of Batemans Bay, 35°42'S, 151°06'E, on *Casuarina*, *K.Kalb 18238, 18921*, 4.viii.1988 (herb. KALB); ibid., *J.A. Elix 22360*, 4.viii.1988 (ANUC); Jerrawangla State Forest, Twelve Mile Road, near Boyd Lookout, 35°10'S, 150°23'E, alt. *ca* 500 m, on *Leptospermum*, *A.W. Archer P 290*, 29.iii.1992 (NSW); Gibraltar Ranges National Park, track to the Needles, 29°31'S, 151°22'E, alt. *ca.* 400 m, on fallen branch, *A.W. Archer P 440*, 28.viii.1992 (NSW).

NEW ZEALAND, North Island, Egmont National Park, Ngatoro Track, 26 km S of New Plymouth, 39°15'S, 174°07'E, alt. 590 m, on fallen branch, *J.A. Elix 19232*, 11.i.1985 (ANUC).
South Island, Lewis Pass area, Nina Valley terrace, 42°18'S, 172°23'E, alt. 700 m, *W. Malcolm 743*, 1.ii.1993 (CHR 470254).

Pertusaria thamnolica resembles *P. truncata* Krempelh.but is distiguished from that species by the presence of thamnolic acid and the slightly larger spores. The species is known from New South Wales and the North and South Islands of New Zealand.

Pertusaria velata (Turn.) Nyl., *Lichenes Scandinaviae*: 179 (1861)

Parmelia velata Turner, *Trans. Linn. Soc. London* 9: 143 (1808).

Type: Great Britain, Sussex, on ash tree, *W.Borrer s.n.*, 1805; BM-holotype

Thallus greyish-white to off white, slightly cracked and areolate, surface smooth to slightly wrinkled, dull, lacking soredia and isidia; corticolous; *apothecia* disciform, numerous, scattered or crowded, concolorous with the thallus, 0.5-1 mm diam., discs pale to dark reddish-brown, slightly or densely white pruinose; *spores* 1 (rarely 2) per ascus, ellipsoid, smooth, thin-walled,100-185 μm long, 30-45 μm wide.

Chemistry: K-, KC+ orange red, C+ red, Pd-; lecanoric acid

Specimens examined:
NEW ZEALAND, South Island, Nelson, Cobb River Dam, *Mason s.n.*, Feb. 1959 (OTA 599a, 600a); Maruia Springs, W of Lewis Pass, alt. *ca.* 400 m, *P. Child 1300*, 6.i.1971 (CHR 452779); Lewis Pass, Nina valley, 42°28'S, 172°23'E, alt. *ca.* 700m, *Nothofagus* dominated river terrace, on fallen branch, *W. Malcolm 372*, 2.ii.1993 (CHR 470422); Mt. Arthur, Flora Hut road, 0.7 km W of Flora Saddle, 41°11'S, 172°44'E, alt. *ca.* 950 m, *W. Malcolm 872*, 13.v.1993 (CHR 470256).

Pertusaria velata is a wide-spread species with a pantropical and temperate distribution (Dibben 1980:78) characterised by disciform apothecia and the presence of lecanoric acid. Although the asci usually have one spore, two-spored asci were also found in the New Zealand specimens.

KEY TO CORTICOLOUS NEW ZEALAND SPECIES OF PERTUSARIA

[Detailed descriptions of species in the key that are not reported
above are given in Galloway (1985)]

1. Thallus lacking spores, with sterile discs or soralia..2
Thallus with spores, in disciform or verruciform apothecia..............................5

2. Thallus sorediate, with white soralia, K-, Pd+ yellow, psoromic acid....*P. psoromica*
Thallus with sterile discs...3

3. Discs K-, KC+ violet; picrolichenic acid...*P. truncata*
Discs K+ violet or yellow, KC -..4

4. Discs K+ violet, Pd-, hypothamnolic acid...............................*P. novaezelandiae*
Discs K+ yellow, Pd+ yellow, thamnolic acid.............................*P. thamnolica*

5. Apothecia disciform...6
Apothecia verruciform..12

6. Spores 8 per ascus..7
Spores 1 per ascus..9

7. Spores spherical, 15-20 μm diam.; discs K-, KC-; lichen compounds absent.........
....*P. sporellula*
Spores ellipsoid, 20-32 μm long; discs K+ yellow or KC+ violet......................8

8. Discs K-, KC+ violet, Pd-..*P. truncata*
Discs K+yellow, KC-, Pd+ yellow...*P. thamnolica*

9. Discs K-..10
Discs K+ violet or K+ yellow...11

10. Discs C-; ....*P. circumcincta*
Discs C+ red, lecanoric acid; ....*P. velata*

11. Discs K+ violet, Pd-; hypothamnolic acid.............................*P. novaezelandiae*
Discs K+ yellow, Pd+ yellow; thamnolic acid; ....*P. scutellifera*

12. Spores 2 (or rarely 3) per ascus..13
Spores 4 or 8 per ascus...17

13. Spores >150 μm long...14
Spores <150 μm long...15

14. Verrucae conspicuous, raised; spore wall rough; spore length 160-250 μm...........
....*P. sorodes*
Verrucae inconspicuous, immersed; spore wall smooth; spore length 210-300 μm
....*P. hadrospora*

15. Ostioles pale, translucent; thiophaninic and stictic acids...............*P. schizostomella*
Ostioles black; stictic acid absent...16

16. Thiophaninic acid present; spores rarely 3 per ascus; ....*P. alboatra*
No lichen compounds present; spores always 2 per ascus; ....*P. melaleucoides*

17. (12) Spores 4 per ascus, spore walls rough; thallus isidiate..............*P. subisidiosa*
Spores 8 (sometimes 6-8) per ascus, spore walls smooth; thallus not isidiate........18

18. Spores predominantly uniseriate, ostioles black or pale................................19
Spores predominantly biseriate, ostioles black..23

19. Ostioles black, conspicuous..20
Ostioles pale, inconspicuous...21

20. Spores 50-70 μm long; thiophaninic acid..*P.laevis*
Spores 30-37 μm long; 4,5-dichlorolichexanthone............................*P. parvula*

21. Thallus lacking lichen compounds; spores 50-62 μm long..................*P. albissima*
Thallus with lichen compounds; spores 70-100(-120) μm long......................22

22. 2-*O*-methylstenosporic acid present...*P. leucoplaca*
2',2-di-*O*-methylstenosporic acid present................................*P. subplanaica*

23. (18) Spores <80 μm long..24
Spores >80 μm long...25

24. Thallus KC+ yellow, arthothelin & thiophanic acid; ....*P. bartlettii*
Thallus KC-, lacking lichen compounds;....................................*P. leucodes*

25. Thallus K+ red, Pd+ yellow; norstictic acid; ....*P. celata*
Thallus K-, Pd-; thiophaninic acid; ....*P. theochroa*

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ALTERNARIA THEMES AND VARIATIONS (74-105)

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ABSTRACT

This paper includes clarification of an earlier paper on euphorbiicolous *Alternaria* species (Simmons 1986), most notably on *Euphorbia pulcherrima* and *E. marginata*, and expansion to include opinions on all taxa of *Alternaria* and somewhat similar genera that have been described from euphorbiaceous substrates. Proposals of *A. acalyphae* (Nelen) Simmons, comb. nov. (= *Macrosporium acalyphae* Nelen; on *Acalypha australis*); *A. obtecta* Simmons, sp. nov. (on *Euphorbia supina* and *E.marginata*); *A. constricta* Simmons, sp. nov. (on *E. marginata*); *A. agripestis* Simmons & Mortensen, sp. nov. (on *E. esula*); *A. subulata* Simmons, sp. nov. (on *E. hirta*); *A. acalyphicola* Simmons, sp. nov. (on *Acalypha indica*); *A. heveae* Simmons, sp. nov. (on *Hevea brasiliensis*); *A. cicina* Simmons, sp. nov. (on *Ricinus communis*).

XIII. (MOSTLY) *ALTERNARIA* ON EUPHORBIACEAE

Introduction

Taxonomic interest in euphorbiicolous species of *Alternaria* in the past decade has included incitants of a disease affecting commercial production of poinsettia (*Euphorbia pulcherrima* Willd. ex Klotzsch) and of a disease of an agronomic pest, leafy spurge (*E. esula* L.). Two papers published within two months of each other in the winter of 1985-1986 (Yoshimura et al. 1985; Simmons 1986) discussed *Alternaria* taxa on species of *Euphorbia*. Both papers contained proposals for combining the epithet of *Macrosporium euphorbiae* Bartholomew (1908) with *Alternaria*, and each selected a lectotype specimen for the name from among specimens distributed by Elam Bartholomew in *Fungi Columbiani No. 2633* (1908).

The proximate dates of publication (December 1985 and February 1986), differences in author interpretation of Bartholomew's species because of reliance on different portions of his original collection(s), and the misapplication of the name *A. euphorbiae* to the poinsettia pathogen (correct name = *A. euphorbiicola*) are creating needless confusion in pertinent herbaria, reference culture collections, and derivative publications (e.g., Holliday 1992, and abstracting journals such as the *Review of Plant Pathology*).

The following observations are organized to present:

1. Opinions on the identity and nomenclatural status of each taxon described in *Alternaria*, *Embellisia*, *Macrosporium*, *Stemphylium*, and *Ulocladium* (plus *Botryosporium prorumpens* Schweinitz) whose substrate is euphorbiaceous.

2. A more detailed discussion of the typification of *A. euphorbiae* (Barth.) Aragaki & Uchida, particularly with reference to the hazards of studying different packets of an exsiccata issued in 70 sets of supposedly duplicate or multiple units, as Bartholomew is reported to have done for *Fungi Columbiani* (Stevenson 1971).

3. The results of a recent review of approximately 130 fungus specimens and isolates from euphorbiaceous substrates, primarily from **BPI** and **IMI**, but also from **NY** and other institutional herbaria as well as from several individual contributors.

The number of novelties described below will not seem extravagant when it is realized that conidia of at least four taxa of *Alternaria* are present on the collection of spotted leaves of *Euphorbia marginata* Pursh chosen by Aragaki and Uchida as lectotype of *A. euphorbiae*, and that the single genus *Euphorbia*, with its 2000 species, contributes less than half of the taxa suggested for the Euphorbiaceae, with its 300 genera and 5000 species (Willis 1985).

Conventions used in this discussion include: herbarium and culture collection abbreviations are from Holmgren et al. (1990), given here in boldface type; references to my records of material studied are in record volume-page format, e.g., EGS 41-034; ICBN refers to the International Code of Botanical Nomenclature (Greuter et al. 1988, except when an earlier edition is specified); an abbreviation "Alt.T&V" often is used to simplify reference to this series of papers on *Alternaria* (Simmons 1981-1993), usually with a number specifying a pertinent unit in the series; routine culture conditions include PCA, Hay, and V-8 agars (Simmons and Roberts 1993, p. 136) in plastic Y-plates at ca. 22C under a 10/14hr, cool-white fluorescent light/dark cycle; microscopic details are recorded from observations made at 195X and 780X.

Chronological Overview of Taxon Names Attributed to Phaeodictyosporous Hyphomycetes Described on Euphorbiaceae

74. **1832** *Botryosporium prorumpens* Schweinitz
Trans. Amer. Phil. Soc., n.s., 4: 306. *In Euphorbiae epidermide...Bethlehem [Pennsylvania]*.

Lectotype: FH, *Botryosporium prorumpens*, Schw! in Euphorbia & Diantho; Herb. Schw. (EGS 38-026).

The original Schweinitz specimen associated with this name bears several different fungi. The collection itself has been subdivided over the years, with portions now held at least in BPI (herb. Michener); FH (herb. Curtis); K (herb. Berkeley); and PH (herb. Schweinitz).

Damon (1952) reported that a fungus in the BPI portion appeared to be "of the general type found in *Stemphylium*" and illustrated two spores that could belong to one of several different genera but not to *Stemphylium* Wallroth. A few very scarce conidia found on the BPI portion (EGS 17-117) are of an *Alternaria* of the *A. alternata* group.

The FH portion (EGS 38-026) bears some rare alternarioid elements similar to those of the PH portion (see below), some conspicuous clumps of miscellaneous fungus spore skeletons (presumably deposited by insects, and illustrated in a sketch on the herb. Curtis specimen label), and a moderately extensive group of prorumpent sporodochia of *Epicoccum* (conidia also sketched on the label). I have not examined the K portion, but the records at the International Mycological Institute (IMI) indicate that M. B. Ellis at some time had given the opinion that the fungus on the K portion is an *Epicoccum*.

The PH portion (EGS 12-085) bears numerous phaeodictyoconidia lying detached on the substrate. These are strikingly similar to *Alternaria* conidia, but there is no readily apparent pore or pigmented annulus in the broadly rounded end of the spores; the narrowly tapered end of each of the few conidia examined is fractured. The visible evidence is inadequate to support calling the fungus an *Alternaria*, although it may be.

Schweinitz (1832) described a fungus with rudimentary sporodochia arranged in two to several subconfluent series and bearing very dark fascicles of dark, compressed-globose, pedicellate spores (which he illustrated as being dictyospores). His description and illustration are consistent with the characters of *Epicoccum* Link, although the conidia in his drawing could be interpreted as inverted alternarioid entities. The FH portion of the original specimen bears a good representative of *Epicoccum*. This FH portion of the original collection is chosen here to be the lectotype of *Botryosporium prorumpens* Schw.

Monotypic *Botryosporium* Schw. (1832) is a later homonym of *Botryosporium* Corda (1831), whose own type, *B. diffusum* (Albertini & Schw.) Corda, probably is conspecific with *B. longibrachiatum* (Oudem.) Maire (fide Mason 1928). The genus name *Botryosporium* Schw. is illegitimate (ICBN Art. 64); its type is a species of *Epicoccum*.

75. **1878** *Macrosporium compactum* Cooke
Journ. Linn. Soc., Botany, 17: 142. *On stems of Ricinus. Houston (Rav. 272, 273).*

Lectotype: BPI 0445206, *Macrosporium compactum* Cke., on *Ricinus*, Houston, Texas, Apr. 16, 1869, H.W.R. 273/B. (EGS 07-109).

Cooke (1878) described this fungus as dark and effuse on a compact crust, with simple, brown, septate, fasciculate conidiophores, and with oval, obtuse, sooty brown, cellular conidia 20-30 x 12-14 μm.

Cooke also illustrated his concept of *M. compactum* in a plate of figures accompanying a paper on New Jersey fungi (Cooke and Ellis 1878, Pl. 99, fig. 15). Although this illustration cannot be tied directly to the typification of *M. compactum*, the proximate dates of the two publications should give weight to Cooke's linking a description and an illustration so immediately with a single species name.

The Ravenel specimen bears an intimate heterogeny of sporulation elements of at least *Alternaria*, *Curvularia*, *Pithomyces*, and *Ulocladium* taxa. Cooke's description of sooty brown (*fuligineis*) conidia with obtuse ends and, in particular, his illustration suggest identity with the *Pithomyces* that is present. Certainly the rather pale, sharp-beaked *Alternaria* conidia that are present in abundance do not fit the description.

McClellan (1944), ignoring Cooke's specific characterization of shape, pigmentation and size of conidia, selected conidia from "herbarium type material" (unspecified) that approximated the spore characters of an *Alternaria* isolate from *Ricinus* leaves that he was studying. He proceeded to propose the new combination *Alternaria compacta* (Cooke) McClellan (see Alt.T&V 85 below).

The lectotype of *M. compactum* Cooke, chosen here from among specimens listed in the protologue, is a species of *Pithomyces* Berk. & Broome not readily if at all distinguishable from *P. chartarum* (Berk. & Curt.) M. B. Ellis on the basis of the conidia seen.

76. **1886** *Macrosporium trichellum* (Arc. & Sacc.) Arc. & Sacc. var. *caulicola* Saccardo [as "*caulicolum*"] Sylloge Fungorum 4: 525. *In caulibus emortuis Euphorbiae biglandulosae, La Mortola, Ital. bor. [Penzig].*

Type specimen not found. Variety typified by the Saccardo description, which he copied from observations made by Penzig (1884) on a Penzig specimen discussed in his *Funghi della Mortola*.

Arcangeli and Saccardo (1878) described *Stemphylium trichellum* Arc. & Sacc. on the printed label of a specimen distributed as no. 698 in Series II of the exsiccata *Erbario Crittogamico Italiano* (1858-1885, various authors and publishers). They observed that the fungus, found on leaves of *Euonymus japonicus* L., had 3-5 septate-muriform, fuligenous, ellipsoid to obovoid conidia 30-35 x 18 μm, that it agreed in some respects with *Stemphylium pyriforme* (Corda) Bonorden and a few other dark-spored taxa, and that they wondered if *Stemphylium*, *Macrosporium* and several other similar genera (named) really differed essentially from each other.

Later Saccardo (1881) issued an illustration of this fungus in his *Fungi italici autograph. del.* no. 853 but under the name "*Macrosporium trichellum* Arc. et Sacc.," citing its earlier publication as a *Stemphylium*. The illustration and conidium dimensions match the original 1878 description.

Penzig (1884), in his *Funghi della Mortola*, identified one of his specimens collected on stems of *Euphorbia biglandulosa* as *M. trichellum* Arc. & Sacc. and gave dimensions of conidiophores as 35-50 µm long, of conidia 33-35 x 16-18 µm.

Finally, Saccardo (1886) considered Penzig's fungus to be a distinct variety of the original species because of its comparatively short conidiophores and caulicolous habit on a host different than that of the original taxon. He created the name *M. trichellum* var. *caulicola* Sacc., though there is no evidence either in his entry in the *Sylloge Fungorum* or in his herbarium at PAD that he examined Penzig's specimen.

I have not been able to locate Penzig's collection of this fungus. Without it, it is not profitable to speculate on the nature and identity of the fungus he collected, even at the genus level.

77. **1887** *Macrosporium commune* Rabenh. f. *Ricinis communis* in Berlese and Roumeguère: Revue Mycologique 9: 180.

The entire entry reads "4240 (38) *Macrosporium commune* Rabh. f. *Ricinis communis*. In foliis emortuis. Cerra de S. Bento pr. Coimbra. Juan. 1887."

The name of the forma, if such was the intention, is not accompanied by any sort of diagnosis or description. It is a nomen nudum. The numbers "4240 (38)" refer to specimens issued in Roumeguère's *Fungi selecti exsiccati*. The unit of this exsiccatus that I have examined (NY; EGS 05-075) bears hyphal fragments but, in the single slide preparation examined, no conidia pertinent to this discussion. Additionally, the name, as a forma, would have no prioribile status in nomenclature.

78. **1908** *Macrosporium euphorbiae* Bartholomew Fig. 71
E. Bartholomew, Fungi Columbiani no. 2633, with type description on printed label of exsiccata packet. *On living & languishing leaves of Euphorbia marginata*.

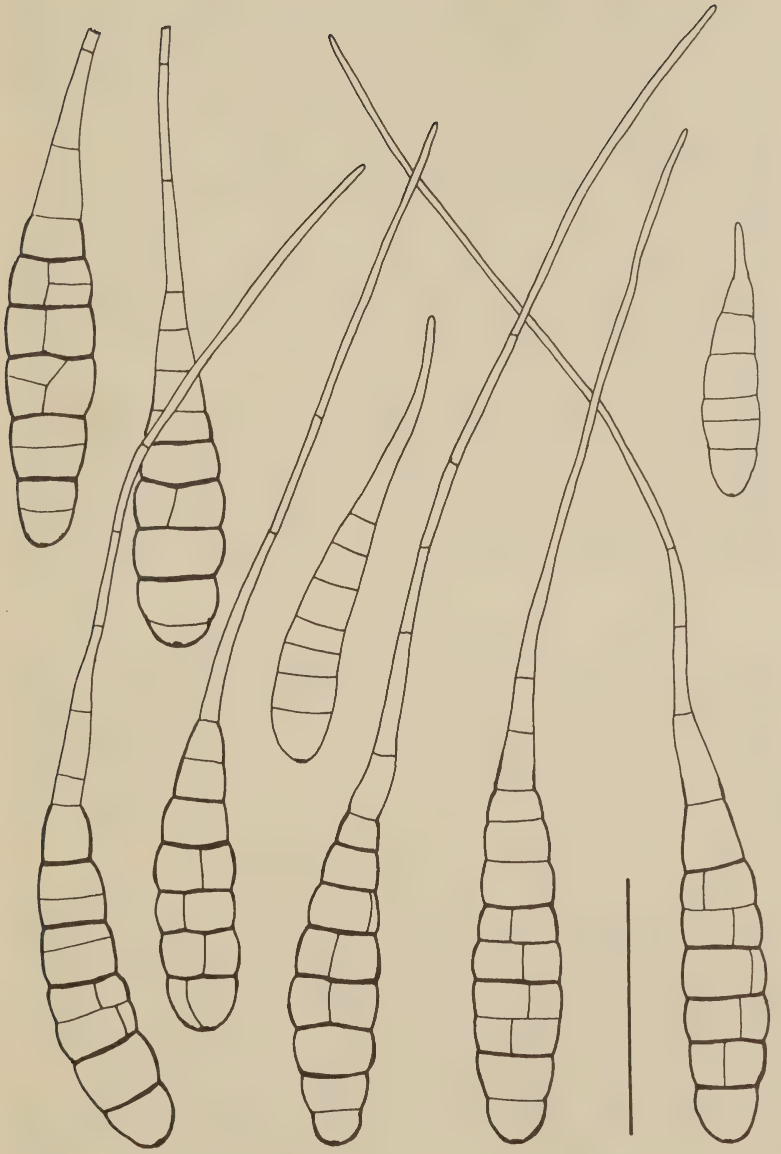

Fig. 71. *Alternaria euphorbiae*: conidia from lectotype of *Macrosporium euphorbiae* Barth. (BPI 0445288). Bar = 50 μm.

Lectotype: **BPI**, certain conidia (Fig. 71) on slide #1 of M. Aragaki and J. Y. Uchida, maintained in a separate packet associated with **BPI** 0445288, a unit of Bartholomew's *F. Col. 2633*, and with an annotation slip "#1 This specimen designated as lectotype of *Alternaria euphorbiae* (Barth.) Aragaki & Uchida. Published by M. A. Yoshimura, J. Uchida & M. Aragaki in Plant Disease, March, 1986 70: 75." (EGS 41-116). [The cited paper appeared in Plant Disease 70 (January 1986): 73-75, which actually was issued in December 1985.]

The herbarium of the National Fungus Collections (**BPI**) contains three packets/units of *F. Col. 2633*. Aragaki and Uchida apparently indicated their lectotype choice to **BPI** but in their published treatment did not specify the actual specimen or the institution involved, stating "The lectotype specimen (designated by M. Aragaki and J. Y. Uchida) fit the description given by Bartholomew, . . ." [The International Code of Botanical Nomenclature in effect in 1985-1986 (Voss et al. 1983) did not require specific mention of the herbarium or institution in which a designated lectotype is conserved. The edition of the ICBN published in 1988 (Greuter et al.) does make such a requirement in Art. 8.4, which became effective 1 January 1990.]

Simmons and Francis (Alt.T&V 14, Simmons 1986) also published observations on *Macrosporium euphorbiae* Bartholomew and, unaware of the Aragaki and Uchida work, selected as lectotype a fungus found in a different unit of *F. Col. 2633* (**NY**; EGS 03-047). Regardless of the merits or differences of observations made by the two different pairs of authors, the Aragaki and Uchida prior choice of lectotype must prevail, and fungus elements present in **BPI** 0445288 must serve as lectotype of *M. euphorbiae* Barth.

However, definition of *M. euphorbiae* within the context of this accepted lectotype choice raises problems for the simple fact that the slide preparation #1, representing the material examined microscopically as a basis for the lectotypification, actually bears conidia of three different species of *Alternaria* and some large, long-beaked conidia of a *Nimbya* taxon. The nature of the three distinguishable kinds of *Alternaria* conidia is taken up in detail in a separate section following this chronological treatment of names (Alt.T&V 97-99). Observations in that place support a caution that all mycotaxonomists (including me) need to heed when dealing with exsiccatae of microscopic fungi in particular, viz., that a fungus name refers to a fungus of a certain circumscription, not to a host lesion of a certain nature, even less to detached portions of field material in a common packet, and most certainly not indiscriminantly to all the putative "isotypes" or "duplicates" distributed by the score in major exsiccatae, only a few of which the distributor could possibly have examined in detail.

The main point in this chronology is to define *M. euphorbiae* as critically as possible on the basis of Bartholomew's type description and the lectotype source. It is not essential at this point to discuss the characters of the *Alternaria* pathogen of poinsettia discussed in the Yoshimura et al. paper (1985) and the Simmons paper (1986) or whether it is the same taxon as *M. euphorbiae* Barth. (although it is not).

Bartholomew described *Macrosporium euphorbiae* in as much detail as was customary for the time. The appearance of the leafspots of the host are not diagnostically helpful, as at least one such lesion provided conidia of the three alternarioid fungi of the lectotype slide. The spots were described as, and are, "amphigenous, brown, suborbicular, subcircinate, lighter at the margin," and in this lectotype unit ca. 3-8 mm diam.

The original description of conidiophores likewise is not specifically applicable because it is too generalized to permit application to one of the conidial types present but not the others. Conidiophores ("hyphae") were given as "amphigenous, dark brown at base, lighter toward the apex, dense, fasciculate, simple, divergent, 2-6 septate," which some are, some are not.

The description of conidia thus becomes the only significant portion of the characterization that permits a choice of the *M. euphorbiae* lectotype from among the diversity of taxa present. Bartholomew continues: "Conidia light brown, obclavate or subelliptical, 4-8 septate, 40-75 x 12-20µ, with frequent longitudinal septa. Apical appendages flexuous, curved, as long or longer than the conidia."

Figure 72 illustrates four kinds of conidia present on the lectotype slide that are pertinent to this discussion. The three *Alternaria* taxa are treated in more detail in Alt.T&V 93, 97, 98, 99.

Fig. 72a An *Alternaria* species with fully developed conidium body 60-80 x 15-18 μm, with 7-9 transverse septa and one, rarely two longitudinal septa in 2-5 of the largest transverse segments of the spore. The outer wall appears smooth and the transverse septa appear distinctly medium brown in color. Apical narrowly filamentous beaks are almost straight to smoothly flexuous, 110-170 x ca. 2 μm.

These conidia represent typical *M. euphorbiae* Barth., i.e., *Alternaria euphorbiae* (Barth.) Aragaki & Uchida, in that they fit the type description well, and certainly better than other conidia present on and illustrated from the lectotype slide. If it should be argued (which I do not) that Bartholomew may have seen and included the other kinds of conidia in his species concept, and that one of them should be designated lectotype, then it is specified here that only the kind of conidia in slide #1 associated with BPI 0445288, as characterized above for Fig. 72A and illustrated here in Fig. 71, are designated as lectotype of *M. euphorbiae* Barth. (See ICBN, Art. 8.1(b), Greuter et al., 1988.)

Fig. 72b An *Alternaria* species with fully developed conidium body 70-85 x 18-20 μm, with 9-12 pale, indistinct transverse septa and one obscure longitudinal septum in 0-2 of the transverse segments. The outer wall is pale, almost hyaline, as are the septa, which seem to be masked by a crowded, extremely minute, punctulate ornamentation. Apical, narrowly filamentous beaks are straight or somewhat curved, 110-120 x ca. 2 μm.

The conidia of this species, with their large body and filamentous beak, are distinguishable additionally in pigment, pattern and indistinctness of septation, and wall ornamentation from those of *M. euphorbiae*.

This taxon is known and has been isolated from other euphorbiicolous sources. It is discussed in more detail below in Alt.T&V 98 as a new species.

Fig. 72c An *Alternaria* species with fully developed conidium body 35-50 x 10-12 μm, with 6-7 transverse septa and usually 1-2 longitudinal septa in each transverse segment except the apical and basal. Wall pigmentation is medium yellow-brown; walls are punctulate roughened overall. Conidia are ellipsoid, tapering apically into a beak cell ca. 18 μm long, or beakless with an apical secondary conidiophore ca. 15 x 4 μm, which characterizes the taxon as chain-forming

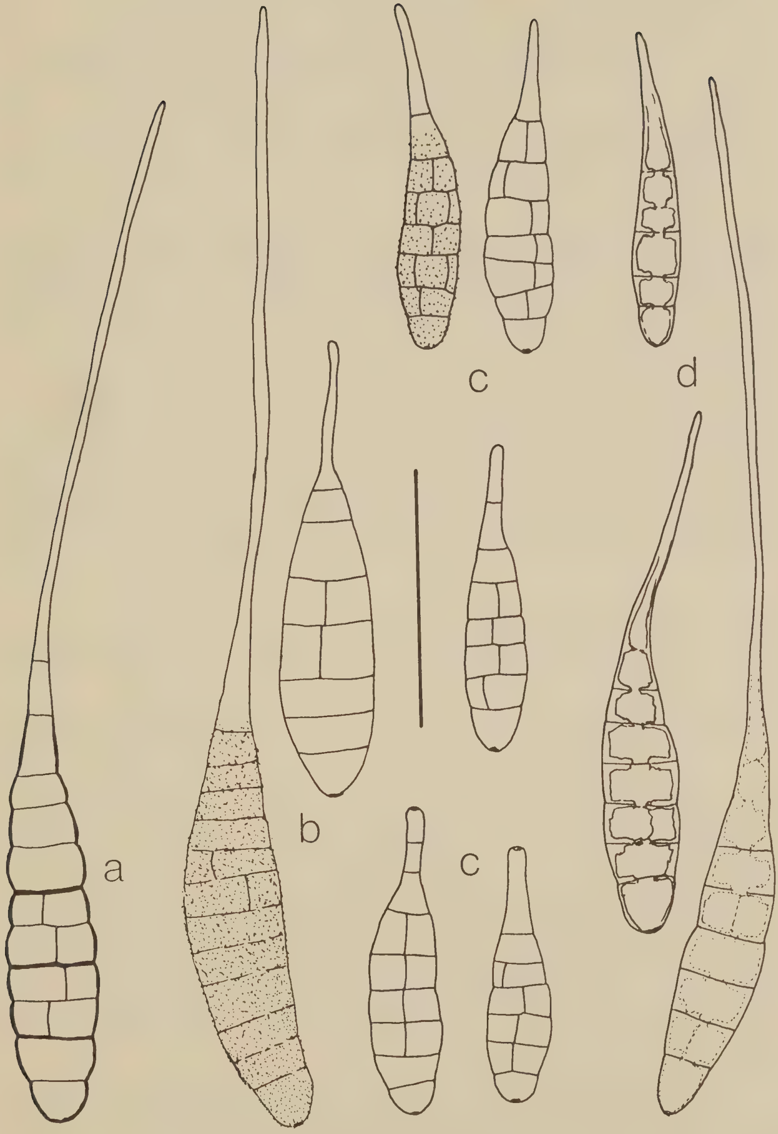

Fig. 72. Conidia of taxa on lectotype slide of *Macrosporium euphorbiae* Barth. (BPI 0445288). a. *Alternaria euphorbiae*, b. *Alternaria obtecta*, c. *Alternaria* sp., d. *Nimbya* sp. Bar = 50 μm.

in nature.

This conidial component of the lectotype slide has only generic resemblance to conidia discussed in Fig. 72a and b above. It is readily separable from the others in the context of this slide, but there are insufficient numbers of conidia for speculation at present as to its identity among similar small-spored species.

Fig. 72d A *Nimbya* species with fully developed conidium body 50-70 x 13-18 µm, with 8-10 transverse, variously angled lacunae partially or completely separated by transverse septa and one longitudinal septum or lacuna partition in 1-3 of the transverse segments. Wall color is a pale yellowish brown. Apical filamentous beaks are straight to smoothly flexuous, 100-170 x ca. 2 µm.

The strongly lacunate, rarely longiseptate conidia of this *Nimbya* contrast well with the typically muriformly septate *M. euphorbiae* conidia in this slide preparation. Here again, there are insufficient numbers of conidia for comparison with other known species of *Nimbya*.

79. 1921 *Macrosporium cavarae* Parisi
Bull. Orto Bot. Univ. Napoli 6: 291. *In foliis Ricini communis*.

Type: published description (l.c.); specimen lacking.

The fungus was described (in Latin) as: conidiophores simple, flexuous, sooty brown; conidia clavate [obclavate?], muriformly septate, with 4-8 transverse septa, somewhat constricted, 34-40 x 10-13 µ, or 39-47 µ with pedicel [beak?], concolorous [with conidiophores?]. Given the widely held concept of *Macrosporium* in 1921, the description may be of a relatively small-spored *Alternaria* with either a short beak cell or a short apical secondary conidiophore 7-8 µm long. In the absence of a specimen this is mostly speculative, even as to genus. The taxon is unknowable on the basis of the information available.

McClellan (1944), followed by Joly (1964), considered *M. cavarae* identifiable with *M. compactum* Cooke, i.e., with *A. compacta* (Cooke) McClellan. The type of *M. compactum*, however, is a *Pithomyces*, which applies automatically to the identity of *A. compacta*. (See Alt.T&V 75 above.)

80. **1921** *Macrosporium euphorbiae* Reichert
Bot. Jahrb. Syst. 56: 723. *Hab. in foliis Euphorbiae prunifoliae (Jack.) J. Müller prope Salamum prope Mansurahm, 6 Decembri 1911 (leg. Schweinfurth in Mus. bot. Berol.).*

Holotype: B, "auf *Euph. prunifolia*, Salamum prope Mansurah. 6.12.1911. S. Schweinfurth." (EGS 09-103).

The pertinent fungus present on leafspots of this collection is an *Alternaria*. It was discussed and illustrated in Alt.T&V 15 as *A. euphorbiicola* Simmons & Engelhard (Simmons 1986), a new name for *M. euphorbiae* Reichert, which is a later homonym of *M. euphorbiae* Barth. (1908).

Largest conidia (ca. 50-60 x 18-20 μm) of the Reichert type specimen are beakless or have a short tapering beak cell up to ca. 10 μm long. Many conidia of the type have produced an apical secondary conidiophore 3-30 x ca. 3 μm. These conidiophores are in no respect the equivalent of the long, sinuous, filamentous beaks seen in the holotype of Bartholomew's *M. euphorbiae*. The sturdy, stiff pseudorostra characterize *M. euphorbiae* Reichert as chain-forming in nature.

The fungus described by Reichert is known from additional herbarium specimens (e.g., from Hong Kong, Tanganyika, U.S.A.) as well as from isolates originating in Florida and Hawaii. This material, observations on it in culture and its relationship to a disease of poinsettia are discussed in Alt.T&V 15 (Simmons 1986) and 95 below under its correct name, *A. euphorbiicola*.

81. **1929** *Macrosporium ricini* Yoshii Fig. 73
Bull. Sci. Fak. Terkult. Kjusu Imp. Univ. 3: 330. [Engl. Summary 3: 330.] *Occurring on the leaves of castor oil plant (Ricinus communis L.), collected at Suigen, Chosen, August 1926, September, 1927, at Hakozaki, Fukuoka, July 16, 1928 (type), September, 1928.*

Lectotype: BPI 0445446, [collected on] *Ricinus communis* [at] Fukuoka [on] July 1928 (EGS 41-106).

I have had the opportunity to examine two Yoshii specimens, the one deposited at BPI and one of later date, July 16, 1929, lent to me by Yoshii in 1956 with the label

"*Macrosporium (Alt.) ricini* Yoshii/*Ricinus communis* L./Hakozaki, Fukuoka, H. Yoshii" (EGS 08-164). The date of the BPI specimen is within the protologue data for the name and, therefore, is chosen as lectotype. The label of the specimen lent in 1956, although marked "Type," bears a date emendation from August 22, 1930, to July 16, 1929, which precludes status as type when the date in the original description clearly is given as month 7 of 1928 (Japanese text) and as July 16, 1928 (English summary). The same fungus taxon is present on leaves of the two different collections, but it is necessary to specify the BPI material as lectotype in accord with ICBN Art. 8 rules on lectotypification.

Yoshii described the fungus as incitant of a leafspot disease characterized by irregular cinnamon-buff spots 10-20 mm. diam. that often are surrounded by a paler halo. His description of the fungus fits [with ES comments noted] the material in the specimen: fasciculate conidiophores light brown to olivaceous, stout, 30-60 x 5.5-7.0 μm, 1-4 celled; conidia greenish brown to olivaceous, fusiform to obclavate with many [4-8] transverse and longitudinal septa, 42-78 x 8.7-19.5 μm, scarcely [nearly always slightly] constricted at the septa, with slender hyaline beak 30-100 x 1.2-1.8 μm.

Yoshii's work, reported in this 1929 paper, included isolation of the fungus and inoculation of test plants, with positive results. He was one prominent mycologist of the time who noted correctly the relative positions of *Alternaria* conidia and their conidiophores, viz., that the conidia are obclavate with rounded base proximal to the conidiophore apex and that the conidium's apical extension is a beak, not a pedicel at the base of the conidium. His excellent photographs (l.c., Tab. 2) leave no doubt as to conidium orientation and morphology.

82. 1939 *Macrosporium rosarium* Penzig var. *piscariae* Sprague, in Sprague and Cooke, Mycologia 31: 51. *On living leaves of Piscaria setigera (Benth.) Peper, South of Mary's River, Corvallis, Benton Co., Ore., O.S.C. 10,916, H. S. Jackson, Sept. 20, 1914.*

Type: illustration and description, Mycologia 31: 49 (Fig. 2, C), 51. 1939. Two portions of the original specimen have been examined in detail, BPI 0455448 (EGS 07-121, 41-108) and OSC 10916 (EGS 12-088). Not a single conidium or conidiophore having the characteristics of the

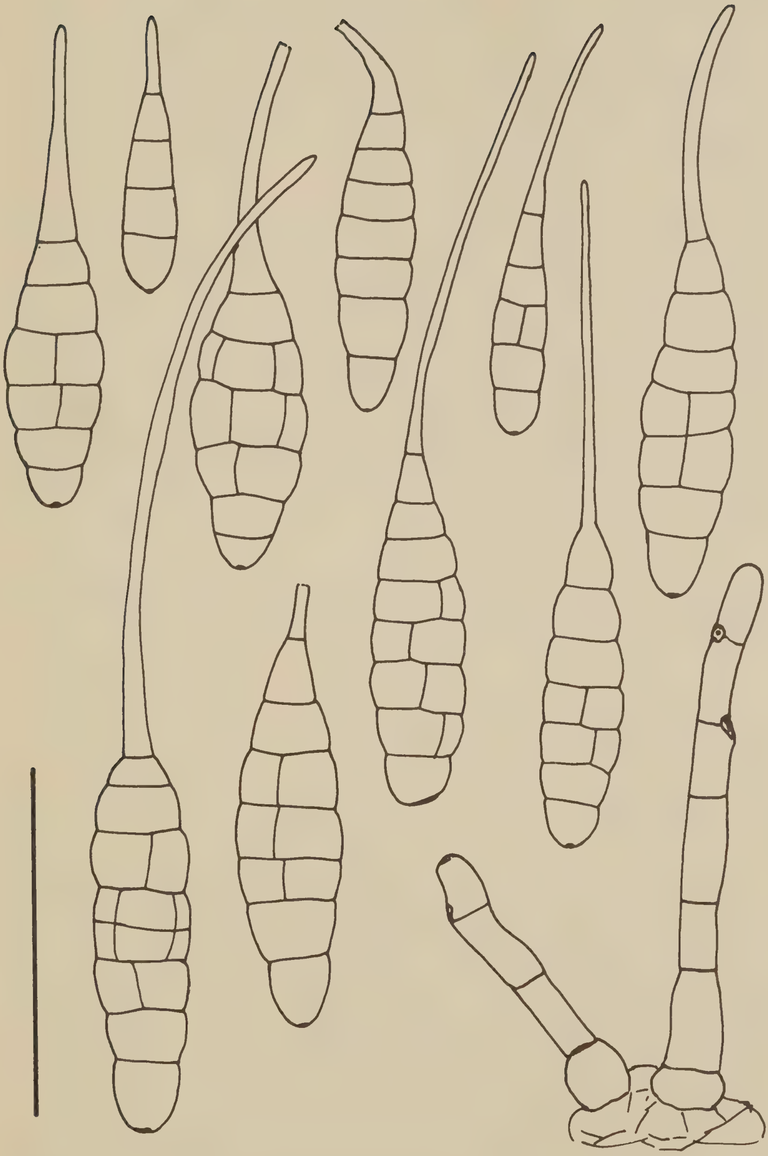

Fig. 73. *Alternaria ricini*: conidia from lectotype of *Macrosporium ricini* Yoshii (BPI 0445446). Bar = 50 μm.

type figure and description has been found, even though presumptive conidia and conidiophores of the kind of fungus described (a *Stemphylium*) usually can be seen readily at 50-60X dissecting microscope magnification. Sprague (in litt. 5-25-58) once suggested that a third portion may have been sent to another herbarium. I have not encountered such in searches for type material.

An excellent *Alternaria* and a *Heterosporium* are present in abundance in the collection. Collector H. S. Jackson described the conidia as "clavatis" in his manuscript notes, so presumably he noted the *Alternaria*. However, the type description, illustration, and reference to *Macrosporium rosarium* Penzig (= *Stemphylium rosarium* (Penzig) E. Simmons 1990) undoubtedly suggest a *Stemphylium*. The type description indicates conidiophores 50-105 x 6-10.5 μm with a series of successive, inflated, internally proliferating conidiogenous cells; pyriform to urn-shaped or subcylindric conidia with muriform (usually 3 strong transverse septa), somewhat constricting septation, are olive-brown, minutely and thickly echinulate, 15-40 x 15-23 μm.

Lacking a specimen and given the current inadequacy of the systematic literature on *Stemphylium*, we now are unlikely to be able to identify this taxon.

83. 1943 *Alternaria ricini* (Yoshii) Hansford Fig. 74
Proc. Linn. Soc. London 153: 53.

Basionym: *Macrosporium ricini* Yoshii (1929). See Alt.T&V 81 above.

Hansford offered the new combination in *Alternaria* on the basis of Yoshii's description and of a specimen (Hansford 8561) collected on *Ricinus communis* in Kampala, Uganda. He added no novel information for the taxon except that "the conidia are occasionally 2-catenulate." I have not seen the Hansford specimen. It is worth noting that Yoshii's type specimen also contains a rare conidium with an apical scar, indicating occasional production of short chains in nature.

Conidia in authentic Yoshii material as well as in field specimens I have seen from several different countries yield a microscopic picture suitable for correct determination of the species on natural lesions, but they are inadequate for identification of the taxon in axenic culture. The

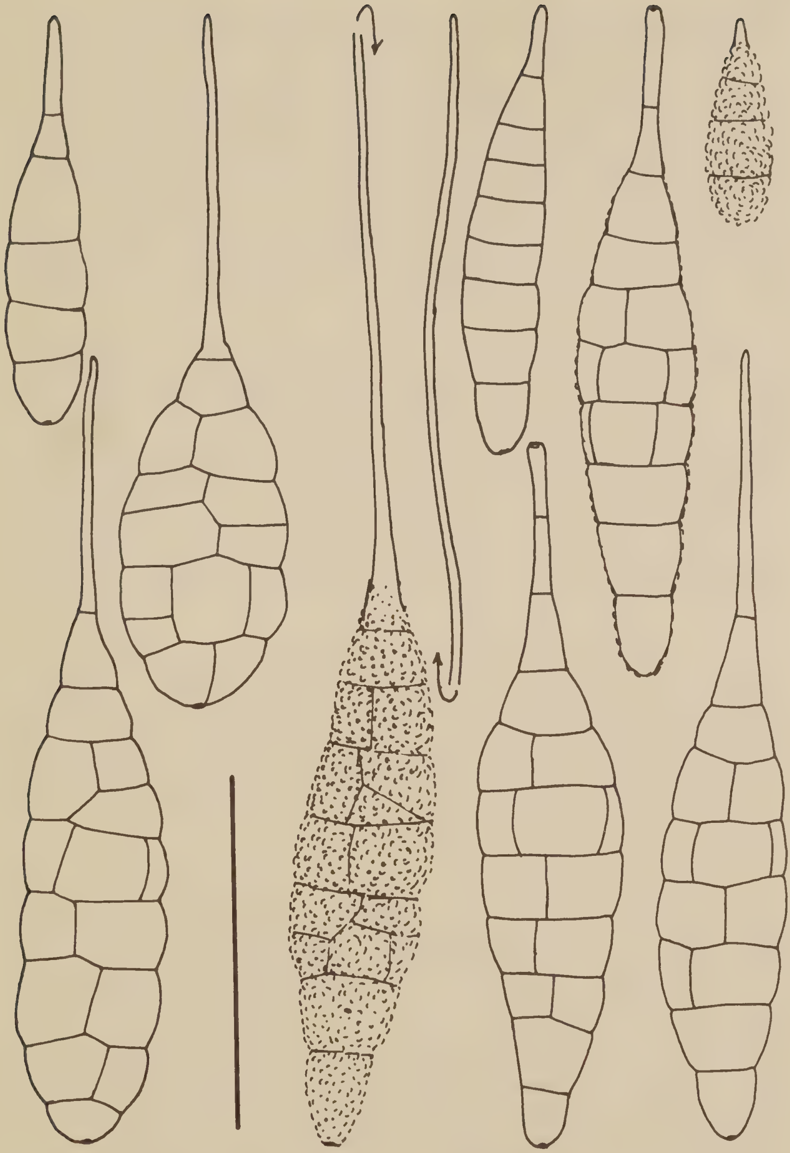

Fig. 74. *Alternaria ricini*: 3 conidia at left from original field specimen; 6 conidia at right (all conspicuously ornamented) from culture 7d. on PCA. Bar = 50 μm. (EGS 06-181)

problem is not subtle (Fig. 74). Mature conidia from the most abundant natural spore populations I have seen (EGS 06-181 from Virginia, U.S.A.; and BPI 044651 ex IMI 68960 from Southern Rhodesia (EGS 41-098)) tend to have a nearly hemispheric or short, rounded obconoid base cell or region and appear quite smooth at 780X. Conidia of comparable maturity in cultures of EGS 06-181 on PCA and V-8 tend to have a strikingly elongate base cell and a densely ornamented outer wall. It is only on relatively non-nutritive Hay agar that conidia similar in proportions to those from nature are produced, and even these Hay-culture conidia are conspicuously ornamented.

The abundant sporulation of field specimen EGS 06-181 has conidia that are already narrowly appiculate when they have only (3-)5 transverse septa (none longitudinal) and are ca. 50 x 10 μm in size. The spore broadens and usually lengthens to become 50-75 x 20-25 μm, narrowing abruptly into a fine, almost rigid beak 60-100 x ca. 1.5 μm. Largest conidia are broadly ovoid to ellipsoid, with 8-9 transverse septa and 1-2 longitudinal septa in each of most of the transverse compartments. Conidium color is a dilute yellowish tan; spore walls appear smooth.

An isolate derived from EGS 06-181 sporulates abundantly on PCA and V-8 agars, less so on Hay. Conidia produced on Hay agar within 1 wk. are, in general, similar to those from the field specimen except that the conidium wall is visibly ornamented. Fully developed conidia are ellipsoid to long ovoid and ca. 65 x 18 μm with a shorter, narrow beak. Secondary sporulation (chain formation) is rare on Hay.

Conidia of EGS 06-181 produced on PCA (my usual comparison medium) and V-8 agars differ strikingly from those on Hay due to the presence of low excrescences evenly spaced, almost crowded, over nearly all of the spore wall, even of the smallest juvenile conidia. Spore bodies of most of the fully developed conidia are long ellipsoid (widest in the middle) or long ovoid (widest below the middle), with a narrow beak. However, conidia with a terminal secondary conidiophore (chain formers) commonly have an unusual obovoid appearance, with the greatest diameter above the middle of the spore body. Young narrow, transeptate conidia tend to broaden variously as they mature without much change in the diameter of the basal one or two cells. These cultural characters of attentuate base and strong ornamentation of conidia need to be added to the *A. ricini* species concept.

84. **1943** *Macrosporium ricini* Sawada
Rept. Agr. Res. Inst. Formosa no. 85: 97. *Collected as a parasite on Ricinus communis, Taihoku, Feb. 4, 1926, by Kaneyoshi Sawada* [orig. in Japanese].

Holotype: **TAI**, on *Ricinus communis* L., Taipei (Taihoku) For., Feb. 4, '26. K. Sawada [modern label in English] (EGS 12-101).

Sawada described a fungus with obclavate conidia extending into a long beak, 3-11 transverse and 0-6 longitudinal septa, 36-130 x 10-23 μm.

A single leaf with a distinct necrotic lesion well darkened by conidia and conidiophores has been examined from the type specimen. Most of the largest conidia have unusually swollen cells. No large conidium in this slide preparation retains an intact beak. The overall impression is of *A. ricini* (Yoshii) Hansford in an overmature, overdeveloped state.

Accepting *M. ricini* Sawada as identifiable with *A. ricini* is a convenient and, I think, correct solution to the handling of the Sawada taxon, for its name is illegitimate, both as a later homonym of *M. ricini* Yoshii and in lacking a Latin description or diagnosis (required by ICBN rules beginning 1 January 1935).

85. **1944** *Alternaria compacta* (Cooke) McClellan
Phytopathology 34: 229.

Basionym: *Macrosporium compactum* Cooke (1878). The lectotype of the basionym is a *Pithomyces*, probably *P. chartarum*. See Alt.T&V 75.

86. **1959** *Alternaria ricini* (Sawada) Sawada
Spec. Publ., Coll. Agr., Nat. Taiwan Univ. no. 8: 208.

Basionym [illegit.]: *Macrosporium ricini* Sawada (1943). See Alt.T&V 84.

The Sawada basionym gains no legitimacy by being transferred to *Alternaria*, where *A. ricini* (Yoshii) Hansford was established legitimately in 1943. The fungus collected and described by Sawada appears to be an overdeveloped growth of *A. ricini* (Yoshii) Hansford, but the names he published illegitimately have no standing in mycological nomenclature, not even as synonyms of the Yoshii/Hansford combination.

87. 1962 *Macrosporium acalyphae* Nelen Fig. 75
Bot. Mater. Otd. Sporov. Rast. Bot. Inst. Akad. Nauk SSSR 15: 142. *Habitatio. In foliis Acalyphae australis L. districtus Kalininensis pag. Rozhdestvenskoje 27 VIII 1952(typus).*

Holotype: **LE**? I have not seen the specimen designated by Nelen as type and said by him to be conserved in **LE**. A later Nelen collection was received from **LE** in response to my request for Nelen types.

Most of the Nelen specimens lent to me by **LE** correspond to respective protologues; a few do not. Having no reason to believe that the type specimen of *M. acalyphae* would not have been sent if it is extant at **LE**, it is reasonable to conclude that it is not and that another specimen authentic with Nelen and matching the type description can be chosen as neotype of the name.

Neotype: **LE**, *Macrosporium acalyphae* Nelen, on *Acalypha australis*, Amurskaya oblast, sepo Taibovka, pole [Amur Oblast, Taibovka village, field], 1 IX 1959, E. S. Nelen. (EGS 20-166).

Nelen described and illustrated a leafspot fungus with oblong-oval, pale brown conidia with 9-12 transverse and 1-2 longitudinal septa, and an apical, hyaline, filiform beak 100-127 µm long. Dimensions of conidium bodies plus beaks are 160-220 x 13-20 µm. Nelen illustrated but did not mention that the conidium beak may be 1-branched and may have up to 8 septa more or less evenly spaced in the narrow beak.

Fully developed conidia of the neotype fit this description well. Juvenile conidia ca. 50 x 10 µm with 4 transepta elongate but remain relatively narrow while a beak as long as 90 µm is produced. The conidium body continues to lengthen, expand, and lay down numerous transverse and a few longitudinal septa; the beak lengthens, becomes septate, and occasionally becomes 1-branched. No surface ornamenta-

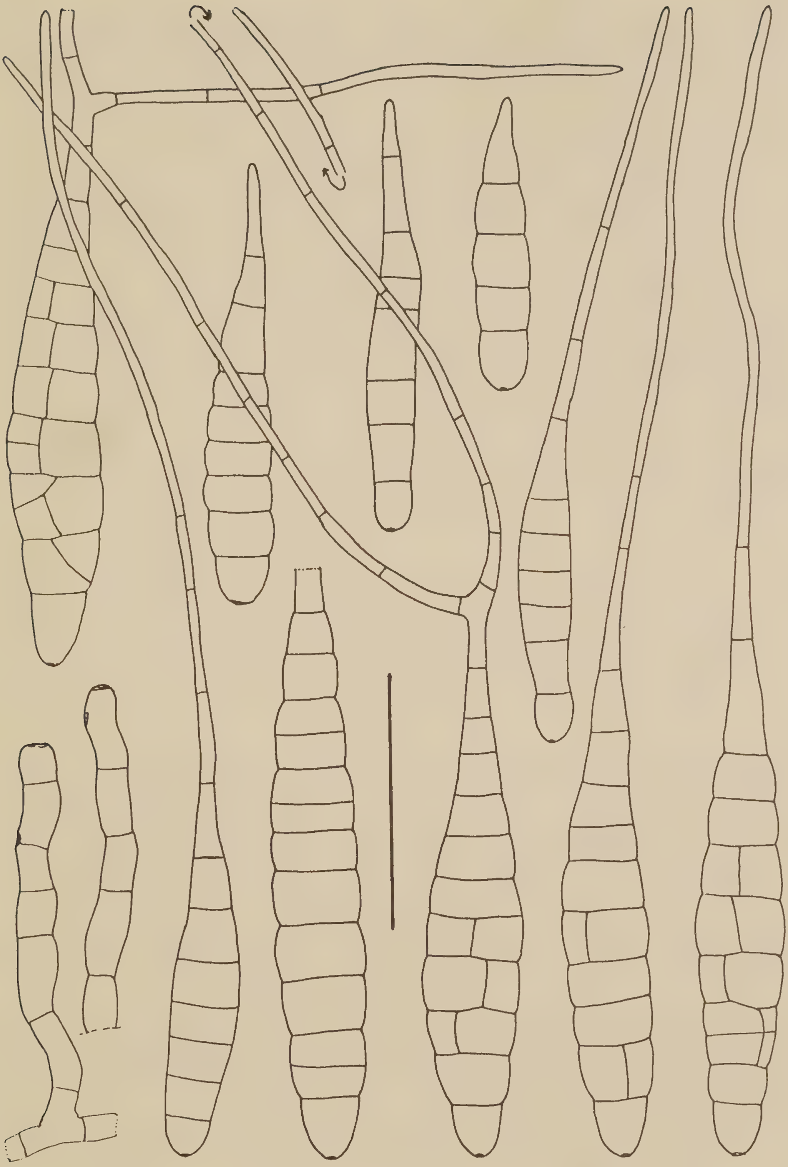

Fig. 75. *Alternaria acalyphae*: conidia and conidiophores from neotype of *Macrosporium acalyphae* Nelen (LE). Bar = 50 μm.

tion is evident on the conidia. The taxon is an excellent representative of a large-spored, filament-beaked *Alternaria*, to which genus the epithet is transferred.

Alternaria acalyphae (Nelen) E. Simmons, comb. nov.

> Basionym: *Macrosporium acalyphae* Nelen, Bot. Mater. Otd. Sporov. Rast. Bot. Inst. Akad. Nauk SSSR 15: 142. 1962. Neotype specified above.

A specimen of *A. acalyphae* was collected by H. C. Greene in Wisconsin in 1948 (WIS, EGS 41-060). He reported it as *Alternaria* sp. on *Acalypha virginica* L. in one of his series of *Notes on Wisconsin Parasitic Fungi* (1949), from which it was compiled in Farr et al. (1989). The conidia of the Wisconsin specimen are for the most part juvenile or young-mature filament-rostrate, rarely with a branched beak. Otherwise the material is typical. No isolate of this fungus is known to me.

88. 1962 *Stemphylium botryosum* Wallr. var. *majus* Batista & Bezerra [as *major*], in Batista, Peres and Bezerra, Inst. Micol. Univ. Recife Publ. 343, p. 17. *Sôbre Croton campestris St. Hil.. . .Ipojuca, Pern. Leg. Dr. Epaminondas de Barros Correia, 5/1/61. Tipo, 217, IMUR.*

The varietal epithet is illegitimate through lack of a Latin description or diagnosis. The specimen that would be considered type if the varietal name were legitimate (URM, EGS 16-087) bears scarce, echinulate *Stemphylium* conidia up to 48 x 22 µm (the authors give 27-43 x 12-19 µm) with 3-4 constricting transverse septa. Judged on the basis of the few conidia and conidiophores seen and the authors' illustration, the taxon is similar to *S. lycopersici* (Enjoji) Yamamoto but certainly not to *S. botryosum*.

The variety has no nomenclatural standing and, due to the scarcity of spores, is unidentifiable more closely than to genus.

89. 1970 *Stemphylium floridanum* Hannon & Weber var. *euphorbiae* Nag Raj & Govindu Sydowia 23(1969): 115. *On living leaf of Euphorbia sp., Hebbal, Bangalore, 2.5.1966, T. R. Nag Raj.*

Type (according to authors): MYSP ǂ 823, with culture from type also deposited in Herb. MYSP. I have not seen either one of these.

The taxon, as described and illustrated by the authors, has conidia "pale to olivaceous brown, oblong, cylindrical or subangular, rounded or acutely pointed at the apex, often with a beak, base truncate or rounded with a prominent basal scar, 3-4 major horizontal septa at which the walls are constricted and many secondary septa, walls verrucose, 41-69 x 14-19 μ in size, usually three times longer than broad."

The conidia described and illustrated are almost certainly recognizable as *S. lycopersici* (Enjoji) Yamamoto (syn. = *S. floridanum* Hannon & Weber) or a variety thereof.

90. 1980 *Alternaria crotonis* Kamal, Singh & Kumar Indian Phytopath. 32(1979): 228. *On living leaves of Croton bonplandianum Baill (Euphorbiaceae); University, Gorakhpur; August 1976.*

Type (according to authors): IMI 206233, leg. R. P. Singh, 18; University, Gorakhpur, U.P., India. I have not found this specimen in the herbarium at IMI; no other specimen of the taxon, as named, is known to me.

The authors describe and illustrate a relatively small-spored fungus, presumably an *Alternaria*, with solitary, rarely catenate, obclavate, olive brown, smooth conidia 7.2-45 x 3.6-10.8 μm (usually 21.6 x 7.2 μm), with (in illustration) 3-4 transverse and rarely 1 longitudinal septa; the tapering apex of the conidia, a beak, is simple, smooth, hyaline, non-septate, up to ca. 20 μm in length.

The authors conclude that a novel species is in hand because "it shows some morphological resemblance" to but differs in one way or another from *A. cheiranthi* (Lib.) Bolle, *A. dianthi* Stev. & Hall, *A. tenuissima* (Kunze ex Pers.) Wilts., and *A. ricini* (Yosh.) Hansf. The comparisons are spurious in that the conidia, as illustrated, have no species resemblance whatever to the taxa listed. *A. crotonis* is unknowable unless the type specimen becomes available.

91. 1981 *Ulocladium manihoticola* Yen Bull. Soc. Mycol. France 97: 132. *Habitat in foliis*

vivis Manihotis utilissimae in Sungei Way, Kuala Lumpur, Malaysia, ad Jo-min Yen, No. 71172, 1 Oct. 1971 (Yen Herb. No. 10573).

Type (according to Yen): Yen Herb. No. 10573, leg. Jo-min Yen, No. 71172, 1 Oct. 1971. Repeated attempts to borrow this and other Yen specimens for examination have been unsuccessful. Information from his institutional connection at the time of his death (LAM) is that his herbarium is in the hands of his family and unavailable.

The taxon, as illustrated, would be difficult to place in *Ulocladium* but very easy to place in *Pithomyces*. Only examination of the type specimen can yield an identification of the taxon.

92. 1983 *Embellisia conoidea* E. Simmons
Mycotaxon 17: 226. *On old crustose, scarcely plastic natural latex of cultivated Hevea sp.*

Holotype: BPI 431684, on natural latex of *Hevea* sp., Java, Indonesia, Feb. 1969. EGS 29-179.

This taxon, with its brown, septate, conoid conidia 13-15 x 5-7 µm produced individually at the apex of progressively geniculate conidiophores, probably would at one time have been considered a rather odd, small-spored *Alternaria*. The decision to segregate somewhat similar taxa with thick, densely pigmented secondary septum layers abutting the paler outer wall of the conidium into a separate genus *Embellisia* E. Simmons (1971) gave a morphologically suitable systematic placement for *E. conoidea*.

The species has no significant resemblance to any other taxon treated here and is included only because the substrate of its type is latex of a euphorbiaceous plant.

93. 1985 *Alternaria euphorbiae* (Barth.) Aragaki & Uchida,
in Yoshimura, Uchida and Aragaki
Plant Dis. 70(1986): 75.

Basionym: *Macrosporium euphorbiae* Bartholomew, Fungi Columbiani no. 2633, iss. 1908, with type description on printed label of exsiccatus packet. Lectotype: from BPI 0445288, as specified above in Alt.T&V 78. See Alt.T&V 78, Fig. 71 for BPI lectotype conidia and Alt.T&V 97, Fig. 76 for a more comprehensive range of conidia from the NY unit of *F. Col. 2633*.

The observations and conclusions given in Alt.T&V 78 for *M. euphorbiae* Barth. need not be repeated here. Typical *A. euphorbiae* has relatively large conidia which might be thought of as belonging to an *A. cucumerina* or an *A. zinniae* morphology group, i.e., with a long ellipsoid or ovoid spore body and a long, narrowly filamentous beak.

Typical *A. euphorbiae* conidia reach 65-90 x 16-18 µm (spore body) plus a beak 120-150 x ca. 2 µm or less. The conidium wall is smooth; both the outer wall and the transverse septa are thin but well defined, with the transverse septa showing a clear, medium golden brown color. Largest conidia have 7-10 transverse septa and 1 or rarely 2 longitudinal septa in 1-5 of the broadest transverse segments. There is no evidence of apical secondary conidiophores, and therefore of chain production, among conidia of the lectotype.

Alternaria euphorbiae has been seen in very few specimens other than the Bartholomew *F. Col. 2633* exsiccati. I know of no isolate of this species.

Interestingly enough, a Kellerman and Swingle specimen #1076, collected on *Euphorbia marginata* at Manhattan, Kansas, Sept. 4, 1887, carries excellent large-spored *Alternaria* material. A portion of this collection in BPI 0445524 (EGS 41-105) has abundant conidia of young-mature, filament-beaked *A. euphorbiae*. Another portion of the same collection #1076 in KSC (EGS 06-140) has abundant conidia of strongly pseudorostrate *A. euphorbiicola* Simmons & Engelhard (Alt.T&V 95). Both portions of this collection also carry conidia of a very distinctive *Stemphylium* of the *S. solani* Weber group. The packets of both portions of the Kellerman and Swingle collection are labeled "*Macrosporium truncatum* E. & K.," a name that never was published and that is given here only as an item of historical interest.

94. **1986** *Alternaria euphorbiae* (Barth.) E. Simmons & S. Francis, in Simmons
Mycotaxon 25: 195.

Basionym: *Macrosporium euphorbiae* Bartholomew, in

Fungi Columbiani no. 2633, iss. 1908, with type description published on exsiccata label. This name was published in *Alternaria* two months after Aragaki and Uchida (1985) had published the same new combination derived from the same basionym. The Simmons and Francis combination is an illegitimate later homonym.

However, each pair of combining authors chose a different unit of *F. Col. 2633* as the source of their lectotype fungus for the name *M. euphorbiae* Barth. Given the diversity of *Alternaria* taxa present in the Aragaki and Uchida lectotype slide (see Alt.T&V 78), it is understandable but unfortunate that each pair of authors chose a different large-spored, filament-beaked *Alternaria* as lectotype. Both species are present in units of *F. Col. 2633*; they are readily distinguishable from each other, especially when examined microscopically side by side. Working strictly within ICBN rules on lectotypification, the Aragaki and Uchida choice of lectotype must be maintained, as explained in Alt.T&V 78. The Simmons and Francis lectotype choice becomes irrelevant to the characterization of *A. euphorbiae*.

Ironically, both pairs of combining authors managed to introduce elements of confusion into the systematics of *Alternaria* species on *Euphorbia* species. Yoshima et al. (1985) attributed an *Alternaria* disease of poinsettia to *A. euphorbiae*, but the fungus they isolated, described, and illustrated from blighted plants is a morphologically different species whose conidia are not present in the lectotype slide of *A. euphorbiae*. (See *A. euphorbiicola*, Alt.T&V 95 below.)

Simmons and Francis (Simmons 1986) chose as lectotype a species whose large, filament-beaked conidia differ in width, pattern and definition of septa, and beak length from lectotypical *A. euphorbiae*. Conidia of this as yet unnamed species are present in *F. Col. 2633* units at BPI 0445288 (Aragaki and Uchida slide #1; EGS 41-116), NY (EGS 03-047, 41-126), and PUR (EGS 41-128). The same species is known from collections from other countries and from a Florida isolate received for opinion in 1986. This material is used as the basis of a new species proposal in Alt.T&V 98 below.

95. **1986** *Alternaria euphorbiicola* E. Simmons & Engelhard, in Simmons
Mycotaxon 25: 196.

An avowed substitute (nomen novum) for *Macrosporium euphorbiae* Reichert (1921) non *M. euphorbiae* Bartholomew (1908). Holotype: B, *auf Euph. prunifolia, Salamum prope Mansurah. 6.12.1911. S. Schweinfurth* (EGS 09-103). See Alt. T&V 80 above.

Alternaria euphorbiicola is the correct name for a species with erostrate to short taper-beaked conidia that very frequently become strongly pseudorostrate, both in nature and in culture. The conidia of this taxon do not produce the narrowly filamentous beaks characteristic of *A. euphorbiae* conidia.

Alternaria euphorbiicola is known from several species of *Euphorbia* (detailed below), including *E. pulcherrima* (poinsettia). A commercially important disease of poinsettia was considered in detail by Yoshimura et al. (1985), where the fungus was misidentified with Bartholomew's *M. euphorbiae* (i.e., *A. euphorbiae*), and in passing by Simmons and Engelhard (Simmons 1986), where the fungus was given a new name to replace the homonym *M. euphorbiae* Reichert.

Alternaria euphorbiicola is known not only from the type specimen from Egypt (B, on *E. prunifolia*; EGS 09-103) but also from Australia (BPI 0445274, on *Euphorbia* sp., USDA-PPQ intercept Oct. 1962; EGS 41-104), Hong Kong (IMI 118473, on *E. pulcherrima*, March 1966; EGS 26-110), Tanganyika (IMI 106673a, on *E. grantii* Oliver, February 1964; EGS 26-108), USA-Florida (Engelhard 6386, 6392, 6468 isol. from *E. pulcherrima*; EGS 38-080/-081/-082), USA-Hawaii (Aragaki 1090, 1091, isol. from *E. pulcherrima*; EGS 41-028/-029), USA-Kansas (BPI 0446300, on *E. marginata*, Bartholomew, July 1899; EGS 41-094), USA-Kansas (KSC, on *E. marginata*, coll. Kellerman and Swingle no. 1076, Sept. 1887; EGS 06-140), USA-Louisiana (H. L. Walker, isol. from *E. heterophylla* L., EGS 38-131, and from *E. hyssopifolia* L., EGS 38-191).

The conidium body length of both *A. euphorbiicola* and *A. euphorbiae* may reach 80-90 μm, but the width of the former reaches 18-20 μm (in type) whereas that of the latter reaches only ca. 15 μm (in lectotype). Conidia of *A. euphorbiicola*, essentially beakless, have an altogether more robust appearance than do those of *A. euphorbiae*. In addition, sporulation of *A. euphorbiicola* in nature is decidedly catenate by means of sturdy apical secondary conidiophores, whereas *A. euphorbiae* with its very long, sinuous, filamentous beaks gives no evidence of secondary conidium production in the natural specimens examined. Isolates of *A. euphorbiicola* sporulate prolifically in culture, where colonies on PCA produce conidia that commonly reach a size range of 88-112 x 29-32 µm before secondary conidiophores develop. Secondary conidiophores, usually ca. 10-15 µm but often 28-48 µm long, have a diameter of ca. 4.5 µm until they expand into a conidiogenous tip cell ca. 5.5 µm diam. (And see Alt.T&V 15, Fig. 28; Simmons 1986.)

96. **1986** *Alternaria angustiovoidea* E. Simmons
Mycotaxon 25: 198. *On lesions of Euphorbia esula L., Manitoba, Canada.*

Holotype: BPI 0445899, dried culture ex isol. K. Mortensen 82-53, 27 July 1982, Manitoba, Canada (EGS 35-172).

This pathogen of a field pest, leafy spurge, is known as isolates from Iowa and North Dakota, U.S.A., as well as from Canada. It has little resemblance to any other taxon on *Euphorbia* species described through 1986, in that its heavily ornamented, usually narrowly ovoid to ellipsoid, long pseudorostrate conidia are produced in moderately long, usually unbranched chains of 8-10 units. Conidia 50-75 x 10-15 µm in size often produce apical secondary conidiophores in a 50-75(-100) x 4-5 µm range. (And see Alt.T&V 16; Simmons 1986.)

Elam Bartholomew's *Fungi Columbiani 2633* and Some of Its *Alternaria* Contents

Stevenson (1971) reports that Bartholomew proposed to issue 70 copies of each Century of *Ellis and Everhart's Fungi Columbiani* when he took over as editor and publisher of this exsiccata with Century XVI in 1901. (The full name had been reduced simply to *Fungi Columbiani.--E. Bartholomew* on specimen packets by the time no. 2633 of Century XXVII was issued in 1908.)

I have had the opportunity to examine the contents of six packets of *F. Col. 2633*, each with its original printed label carrying the type description and collection data of *Macrosporium euphorbiae* Bartholomew. The six packets are in **BPI** 0445288, 0445289, 0445290 (EGS 41-116, 41-117; 41-118); **NY** (examined twice, EGS 03-047 and 41-126); **PUR** (EGS 41-128); and **WIS** (EGS 01-196).

The 3-4 *Euphorbia* leaves in each packet are in good to excellent condition. Each leaf has several small, brown, round lesions, as described by Bartholomew, some of them obviously covered densely with fungus growth but others not conspicuously so. A few leaves also have 1-2 small fungus-bearing lesions that are somewhat irregular rather than quite circular in outline. A cursory macroscopic examination gives an impression that the packet contents are "duplicates," in the sense of appearing to be portions of one large collection from a single host colony, or at least of several specimens of one host species, all exhibiting the same kinds of leafspot lesions.

Examination of even an extremely limited sampling of fungus material from leaf lesions in each packet (at 195X and 780X) invites a state of alternarial shock or at least surfeit from the presence of at least four quite distinct *Alternaria* taxa. An inevitable cautionary note comes to mind, to the effect that neither the specialist nor the tyro mycotaxonomist should expect that leafspots collected in summer and autumn of Midwest U.S.A. (or anywhere, for that matter) will bear pure stands of single fungus species or that different lesions on a leaf will necessarily bear the same fungus taxon.

This observation, the diversity of conidium morphology observable on the *Macrosporium euphorbiae* lectotype slide (see Alt.T&V 78 above), and the published differences of opinion on the identity of the taxon have suggested a review of slide preparations from units of *F. Col. 2633* that have been readily available to me.

WIS (EGS 01-196) My first encounter with a unit of *F. Col. 2633* was disappointing, in that an *Alternaria* taxon present could not be identified with the characterization presented in the accompanying type description. The obvious *Alternaria* present is a taxon that can be found on a high percentage of leafspots of herbaceous and woody plants in temperate climates (cfr. Alt.T&V 46, Fig. 51; Simmons 1990).

NY (EGS 03-047) A second encounter with *F. Col. 2633* yielded conidia of a fungus that determined my concept of the taxon until 1986, when Simmons and Francis presented it as their choice of lectotype of *M. euphorbiae* Barth. and proposed *Alternaria euphorbiae* (Barth.) E. Simmons & S. Francis, comb. nov. This fungus is discussed in Alt.T&V 14 with Fig. 27 (Simmons 1986). It is a large-spored, filament-beaked

Alternaria that matches part but not all of the type characterization. With the experience of having examined several portions of *F. Col. 2633* , it is safe to say that this taxon is not *A. euphorbiae*, although it is present in several units of this exsiccatus. Its choice as lectotype of *M. euphorbiae* Barth. was preceded by the Aragaki and Uchida lectotypification (Yoshimura et al., 1985), as explained in Alt.T&V 78. As a distinct, as yet nameless *Alternaria*, it is described below as a new species on the basis of modern material (Alt. T&V 98).

BPI 0445288 (EGS 41-116) An identification problem (early 1993) with a quite different, at first sight novel *Alternaria* from *Euphorbia esula* in Manitoba and Saskatchewan, Canada, plus the need to clarify the identity of *A. euphorbiae* on *E. marginata* and *A. euphorbiicola* on *E. pulcherrima*, lured me into reviewing slides from some 130 specimens of *Alternaria*, *Macrosporium*, *Stemphylium*, etc., from substrates of Euphorbiaceae held mostly at BPI and IMI.

Among BPI holdings are three packets of *F. Col. 2633*. Each of the three is stamped TYPE. One, BPI 0445288, is accompanied by a microscope slide preparation marked #1, representing the evidence of lectotype choice made by Aragaki and Uchida. As mentioned above (Alt.T&V 78) conidia of three different and definable morphologic taxa of *Alternaria* (and a probable *Nimbya*) are present in this slide preparation.

I made only one additional slide preparation from this BPI unit of *F. Col. 2633*, from one lesion on which conidia could be seen at 50X magnification. A fourth *Alternaria* taxon, remarkably different from the other three, is present. Each of the four taxa is discussed in turn in Alt.T&V 97-100 below.

97. *Alternaria euphorbiae* (Barth.) Aragaki & Uchida Fig. 76

See Alt.T&V 78 and 93 above for characterization and illustration of the lectotype in BPI 0445288. Conidia of this taxon present in a second unit of *F. Col. 2633*, BPI 0445290, are either old with lateral germination tubes or juvenile, presumably representing a secondary flush of sporulation on the lesion. No conidia of *A. euphorbiae* were found in a preparation from a single likely-looking spot (among ca. 15) of a third unit of *F. Col. 2633*, BPI 445289.

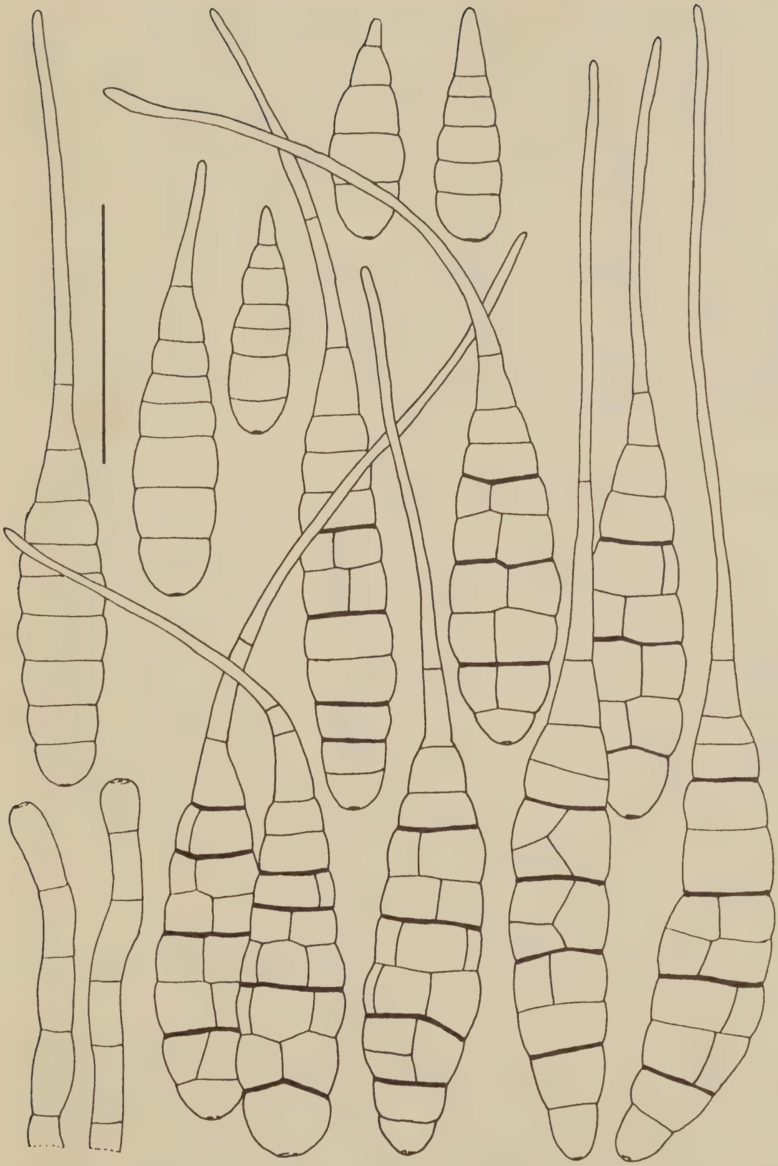

Fig. 76. *Alternaria euphorbiae*: conidia and conidiophores from **NY** unit of *Fungi Columbiani 2633* (*Macrosporium euphorbiae* Barth.). Bar = 50 μm.

Young-mature to fully developed conidia of *A. euphorbiae* are abundant on lesions of two leaves (of four) in the NY unit of *F. Col. 2633* (EGS 41-126). Excellent conidia of the species in all stages of development also are abundant on lesions of all four leaves of the PUR unit of the same exsiccatus (EGS 41-128). The WIS unit provided no *A. euphorbiae* conidia in the single slide preparation obtained (EGS 01-196).

Figure 76 allows presentation of a wider range of *A. euphorbiae* conidium development than is visible in the lectotype slide. *Euphorbia marginata* and *A. euphorbiae* probably still flourish in the neighborhood of Stockton, Kansas (the type locality); modern air-dried specimens suitable for isolation procedures would be received with gratitude.

98. *Alternaria obtecta* Simmons Fig. 77

Alternaria sporulation elements present on some lesions of the *F. Col. 2633* unit at NY (EGS 03-047) were characterized and illustrated by Simmons and Francis in their discussion of *M. euphorbiae* Barth. (Simmons 1986). The fungus is one of two *Alternaria* taxa with large, filament-beaked conidia that occur on this specimen. Typical *A. euphorbiae*, as discussed above in Alt.T&V 74 and 98, is one of the two taxa. The other one, as treated by Simmons and Francis, is not *A. euphorbiae*, although, on the basis of the NY specimen, they considered it to be so at the time. It is, instead, a distinguishable species known from other collections and from an isolate which came to my attention in Nov. 1986. It is described here as novel.

Alternaria obtecta E. Simmons, sp. nov.

Etym.: L. *obtecta*, concealed, covered over, with reference to the obscurant quality of the fine spore ornamentation

Ex cultura in agaro PCA descripta. Conidiophora simplicia vel geniculata, dilute fulva, 30-80 x 4-6 µm. Conidia solitaria, raro in catenis bisporis. Conidia longiovoidea vel ellipsoidea, dilute fulva, usque ad 65-70 x 16-19 µm, rostro recto vel flexuoso ad 110-160 x 1.5 µm, transverse 10-12 et longitudine 2-5 septata, episporio subtiliter et obtecte punctulato. Habitatio typi in maculo Euphorbia supina Raf., Ruston, Louisiana, U.S.A. Holotypus:

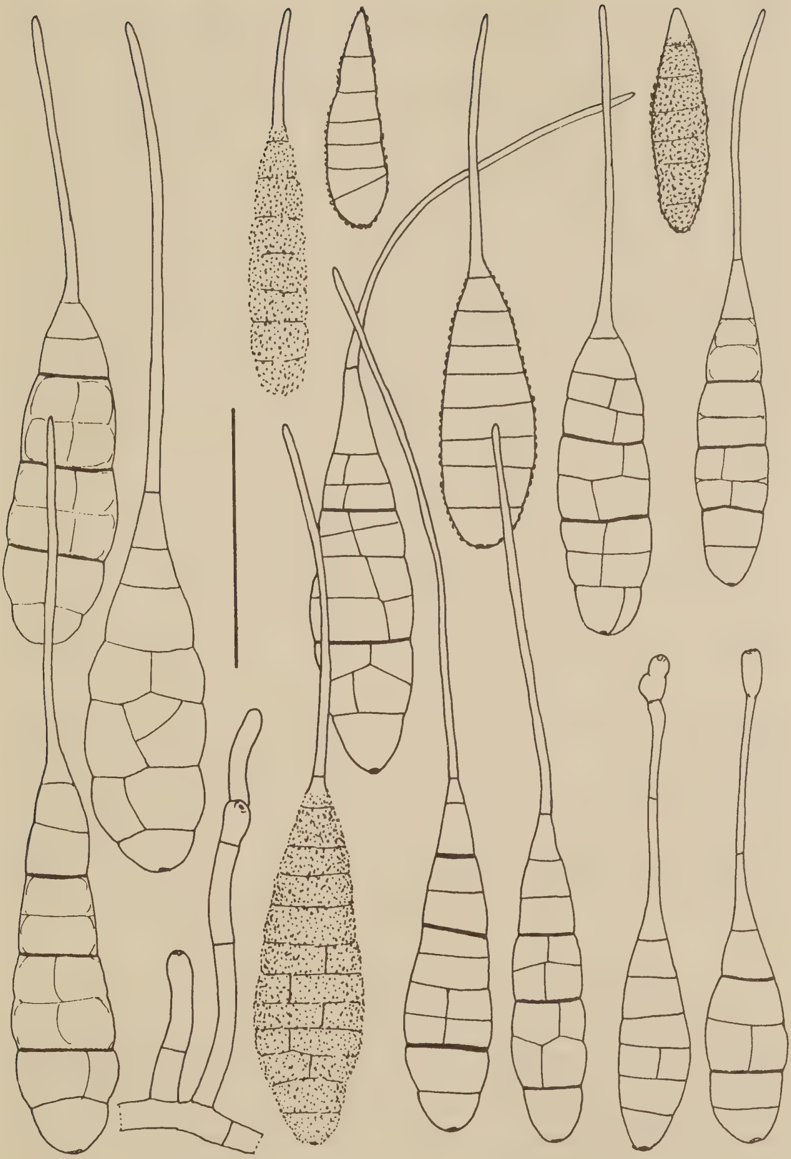

Fig. 77. *Alternaria obtecta*: conidia and conidiophores from holotype (BPI, EGS 38-189); all conidia punctulate to extremely minutely ornamented. Bar = 50 μm.

*pars ex cultura EGS 38-189 desiccata et in **BPI** conservanda.*

Narrowly ellipsoid or ovoid juvenile conidia ca. 40-50 x 10-12 µm have 6-7 transverse septa without evidence of longisepta, a condition that holds as the conidium body broadens, lengthens, and initiates an apical filamentous beak. Even the youngest conidium walls are completely and densely punctulate. The ornamentation persists throughout the development of the spore, as distinct punctulation (at 780X) or as an almost imperceptibly fine covering. The layer of ornamentation obscures the few longitudinal septa to such an extent that the evenly spaced transepta appear (at 195X) somewhat ladder-like. Three or four of the 10-12 transepta in largest conidia are darker and somewhat more constricting than the others; one longiseptum can be found in each of 2-5 of the transverse segments. Ornamentation is less pronounced and obscurant on conidia produced on V-8 agar.

Fully developed conidia are long ovoid or ellipsoid, reaching a size range of 65-70 x 16-19 µm and tapering into a straight to flexuous beak up to 110-160 x ca. 1.5 µm. Conidium color is a pale golden tan. Evidence of chain formation is present, though rare, with the tip of a filamentous beak enlarging to about 10 x 4 µm and becoming conidiogenous.

The holotype was prepared from an isolate received November 1986 from L. Walker, Ruston, Louisiana, as "231 *Alternaria* sp.," from prostrate spurge (*Euphorbia supina*). (The isolate is the property of Mycogen Corporation, San Diego, California.) Conidia of *A. obtecta* are found also on some lesions of *E. marginata* leaves in *F. Col. 2633* (BPI 0445288, NY, PUR) in association with *A. euphorbiae*, *A. constricta*, and various small-spored *Alternaria* taxa.

99. *Alternaria* sp.

The small-spored, chain-forming *Alternaria* that occurs on the lectotype slide of *M. euphorbiae* Barth. along with conidia of *A. euphorbiae* and *A. obtecta* is illustrated above in Alt.T&V 78, Fig. 72, for contrast purposes. Conidia of this taxon are readily distinguishable from those of the other two species. However, too few conidia are present to permit its identification with other small-spored taxa. Most of the conidia are narrowly ellipsoid with either a gradually attenuate true beak or a short, sturdy secondary conidiophore. The largest conidium bodies are dilute ochraceus in color, smooth or finely but distinctly punctulate roughened, ca. 40-45 x 10-13 μm plus a beak ca. 18-20 x 3 μm or an apically perforate secondary conidiophore ca. 15-18 x 4 μm.

100. *Alternaria constricta* Simmons Fig. 78

A fourth distinctive *Alternaria* species that occurs on some portions of Bartholomew's *F. Col. 2633* was noticed first in the single slide preparation made by EGS from BPI 0445288 (EGS 41-129). This is the same unit of *F. Col. 2633* that furnished the lectotype of *M. euphorbiae* Barth. in slide #1 of Aragaki and Uchida, although conidia of this fourth taxon have not been seen on the lectotype slide itself.

Fortunately, good material of this fourth taxon also is found in the NY unit of *F. Col. 2633* (EGS 41-126), which can be used as its holotype.

Alternaria constricta E. Simmons, sp. nov.
Etym.: L., *constricta*, a diagnostic conidium character

Ex specimine siccato descripta. Conidia solitaria vel interdum in catenis. Conidia breviellipsoidea vel ovoidea, ad aliqua transepta primaria distincte et fortiter constricta, erostrata aut longifilamentose rostrata, interdum pseudorostrata et conidifera; dilute sordide fulva, plerumque laevia, 40-65 x 13-18 μm, transverse 4-7 et longitudine 1-3 septata, rostro filamentoso ad 100(raro -150) x 2-3 μm, pseudorostro ca. 40 x 5 μm. Habitatio typi in maculo folii Euphorbia marginata Pursh, Stockton, Kansas, U.S.A. Holotypus: NY, praeparatio permanens lamina vitrea EGS 41-126 ex specimine Fungi Columbiani exs. no. 2633 (non raro alliis speciebus commixta), leg. E. Bartholomew, July 20, 1908.

Beakless conidia and the spore body of rostrate conidia are short ellipsoid or ovoid, distinctly and sometimes strongly constricted at 2 or more major transepta. Conidia apparently may remain beakless, but most produce an apical filamentous beak. Occasionally a conidium extends into a sturdy well-defined secondary conidiophore, or the tip of a filamentous beak enlarges and becomes converted into a functional secondary conidiophore.

Conidium bodies and beakless conidia are dilute dull golden tan in color, apparently quite smooth but occasionally

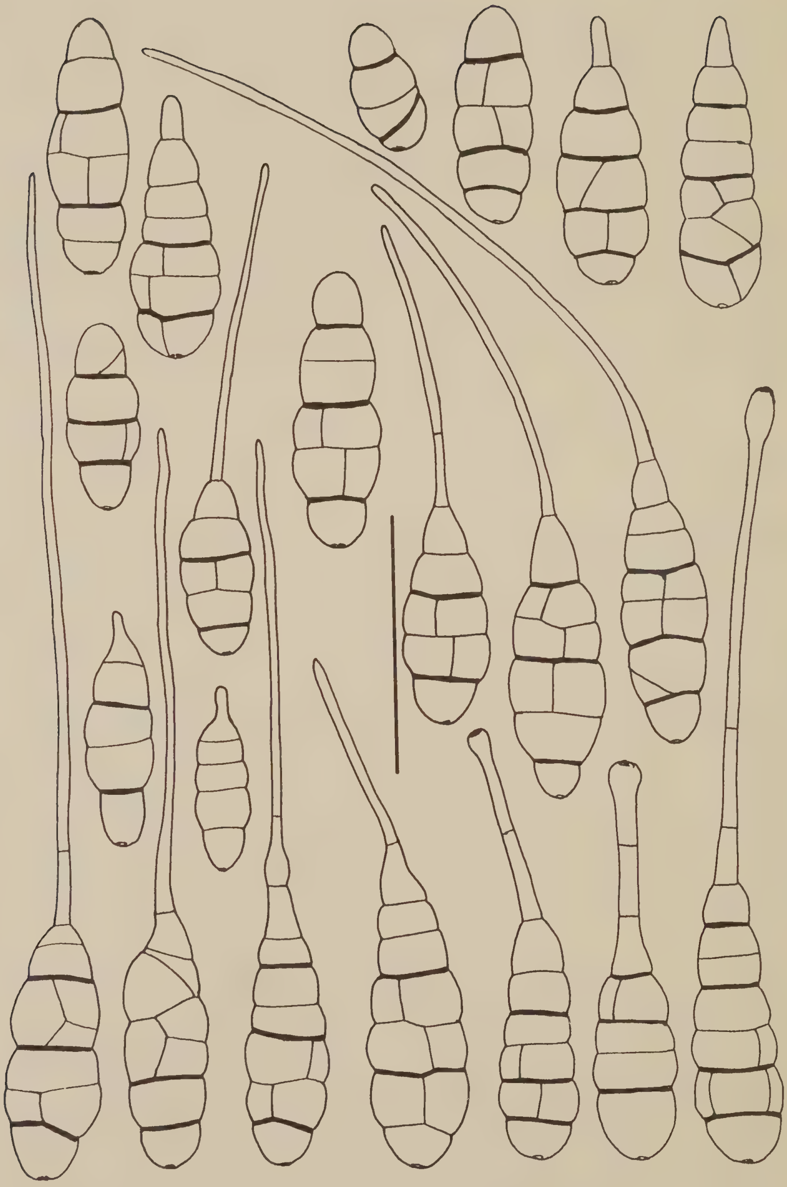

Fig. 78. *Alternaria constricta*: conidia from holotype (**NY**, EGS 41-126). Bar = 50 μm.

with small scattered verrucae, 40-65 x 13-18 µm, with 4-7 darker transverse septa and 1-2 thin, longitudinal or oblique septa in 1-3 of the transverse segments. Filamentous beaks, which commonly arise quite abruptly without tapering from the conidium apex, are straight to slightly curved, and up to 100 (rarely to 150) x 2-3 µm.

The holotype consists of conidia present in a permanent slide preparation EGS 41-126 derived from a single lesion present on a leaf of *Euphorbia marginata* in the specimen of *Fungi Columbiani* no. 2633 in NY. The individual leaf and lesion from which the holotype was prepared are marked for reference.

Additional *Alternaria* Taxa on Euphorbiaceae

101. *Alternaria agripestis* Simmons & Mortensen Fig. 79

Euphorbia esula (leafy spurge), like *E. marginata*, is host to more than one strikingly distinctive *Alternaria* taxon. K. Mortensen was the original isolator of the type of *A. angustiovoidea* E. Simmons (1986) from *E. esula* in Manitoba. His recent sharing of isolates, field information, and supporting evidence of pathogenicity of this additional *Alternaria* from *E. esula* motivated this present review.

Alternaria agripestis E. Simmons & K. Mortensen, sp. nov.
Etym.: L. *ager* + *pestis* (gen.) = of a field pest

Ex cultura in agaro PCA descripta. Conidiophora simplicia vel geniculata, sordide fulva, ca. 80-225 x 6-8 µm. Conidia solitaria, raro in catenis bisporis, longe angusti-ovoidea vel anguste ellipsoidea, sordide fulva, usque ad 80-100 x 16-18 µm, rostro inramoso 200(-250) µm longo x 3-4 µm a 1.5 µm decrescenti vel rostris 1-3-ramosis 100-200 µm longis, transverse 9-11 et longitudine 1-5 septata, laevia, punctulata, vel fortiter verruculosa. Habitatio typi in maculo caulis Euphorbia esula L., Maxim, Saskatchewan, Canada. Holotypus: pars ex cultura EGS 41-034 desiccata et in BPI conservanda.

Well-developed conidia of *A. agripestis*, like those of *A. angustiovoidea*, are strikingly long-narrow ovoid with numerous transverse and very few longitudinal septa. Conidium walls of *A. agripestis* remain smooth to sparsely punctulate or become strongly verrucose under some culture conditions (see below), whereas those of *A. angustiovoidea* typically become densely verrucose. Here the resemblance of the two ends, as *A. agripestis* conidia are solitary with a long narrow beak which often is branched whereas *A. angustiovoidea* conidia are produced in long, usually unbranched chains of 8-10 pseudorostrate units.

Juvenile conidia of *A. agripestis* are narrowly ovate, gradually tapered to a pointed beak, and as large as 50-60 x 8-9 µm when 4-5 transverse septa become visible. Conidia in this stage of growth are subhyaline but already visibly punctulate. Development of long narrow beaks is rapid as the conidium body grows in length and somewhat in width; single long beaks are the common condition on well-developed conidia, once-branched beaks are abundant, and twice-branched beaks are present though rare.

Largest conidia have bodies in the 80-100 x 16-18 µm size range, are dull golden tan in color, 9-11 transversely septate with one longitudinal or oblique septum in each of 1-5 transverse segments. Solitary unbranched beaks are straight to smoothly curved, subhyaline, up to 200(-250) µm long, tapering from a base 3-4 µm wide to a fine 1.5 µm apex. Chains of two conidia occur, though very rarely.

The above type description is based on 7-day PCA cultures produced under routine conditions outlined in the introductory comments. Under these conditions sporulation is tardy and sparse. However, abundant sporulation on PCA and enormous numbers of conidia on V-8 can be induced within 24 hrs. by means of an old plate-culture trick, viz., scarification of the colony surface followed by a few hours of fluorescent-light exposure and overnight hours of darkness.

Conidia of *A. agripestis* produced using this method of culture manipulation are quite similar in size (ca. 72-88 x 14-16 µm) and are densely verrucose in ornamentation, which is concentrated on the lower half to two-thirds of the spore body. Beak branching becomes the rule, with once-branched beaks dominant, twice-branched (3 beaks) common, and thrice-branched (4 beaks) present though rare.

The holotype is from an isolate received 26 January 1993 from K. Mortensen, Regina, Saskatchewan, as a 1-conidium isolate 92-81A from infected stem tissue of *Euphorbia esula* collected by P. Harris, Maxim, Sask., July 9, 1992.

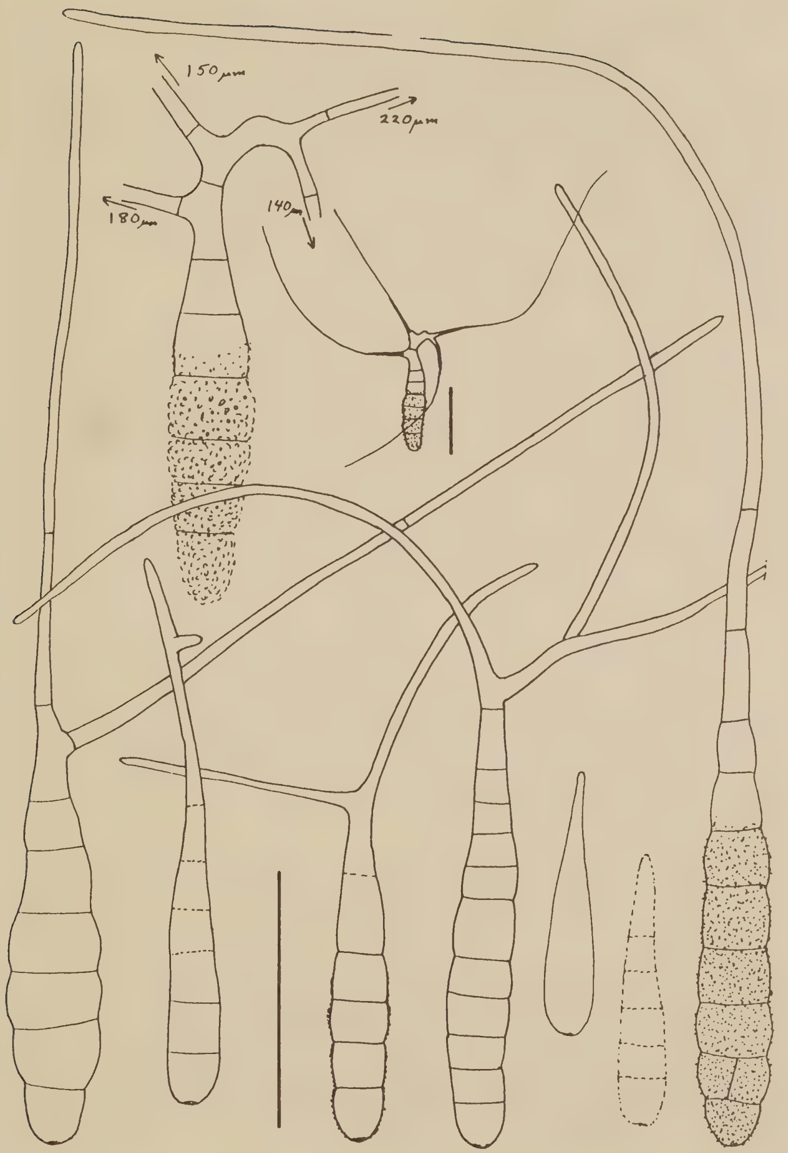
150µm
220µm
140µm
180µm

Fig. 79. *Alternaria agripestis*: conidia from holotype, 7d. on PCA (BPI, EGS 41-034). Bars = 50 µm.

102. *Alternaria subulata* Simmons Fig. 80

M. B. Ellis, hyphomycetologist at IMI for many years until his (semi)retirement, frequently shared with me specimens of *Alternaria* taxa whose identities he did not intend to pursue for one reason or another. He assigned each problem taxon a "taxonomic species" number when depositing examples in IMI. Some of these items are scanty, sometimes only a scrap of host and a slide, and perhaps will never prove usable for classification purposes. Others are quite adequate for comparison work.

It seems pertinent to comment here that sometimes it is difficult to judge whether or not a conidium sample from a field specimen contains fully developed spores along with obvious juveniles. Many small-spored *Alternaria* taxa can produce fairly extensive chains of conidia overnight under dampchamber conditions, even though the original field specimen held only a flush of solitary, noncatenate spores. Defining such a taxon on the basis of the field specimen is misleading and troublesome to classification work, although it has been done many times in the literature of the genus.

Two specimens of "*Alternaria* Tax. sp. XI" (MBE in IMI) present such a dilemma. I have decided to present the taxon here as novel because its specimens contain developmental stages unusual enough for subsequent recognition and because it occurs on a single host species, *Euphorbia hirta* L., in collections made 11 years apart in two widely separated geographic regions, New Guinea and Sudan.

Alternaria subulata E. Simmons, sp. nov.
Etym.: L. *subulata*, awl-shaped; of the conidia, though not so sharp-pointed as a hand-awl (= subsubulate?)

Ex specimine siccato descripta. Conidiophora simplicia, geniculata, dilute ochracea, pluriconidifera, ca. 50-75 x 4-5 µm. Conidia solitaria, anguste ellipsoidea, dilute ochracea, laevia, erostrata 35-50 x 10-13 µm, transverse 4-5 et longitudine 0, raro 1 septata, vel rostro 50-65 x 4 µm. Habitatio typi in maculo Euphorbia hirta, S. Staines, Gusap, New Guinea. Holotypus: IMI 117496b (EGS 22-050), leg. D. Shaw et W. Burnett, 20 January 1966.

Juvenile conidia are ellipsoid and beakless, ca. 25 x 7 µm by the time 3-4 transverse septa have developed. Apical beak growth is initiated at this stage; the beak lengthens

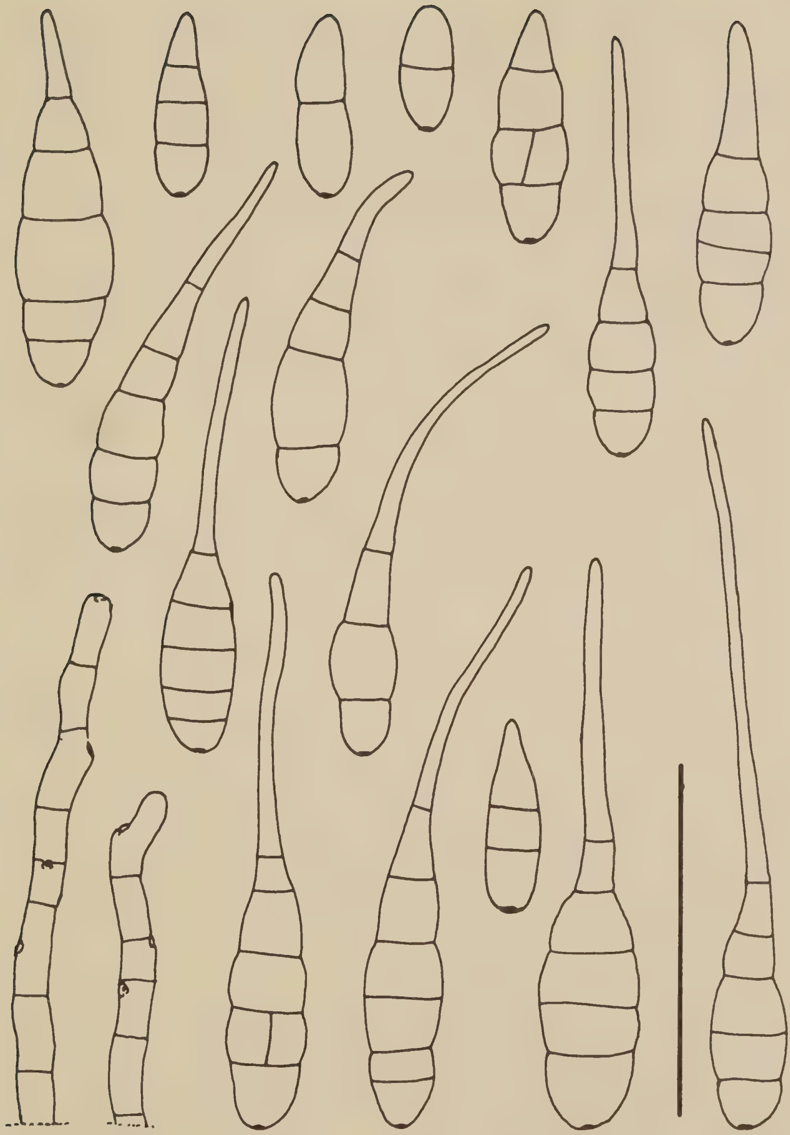

Fig. 80. *Alternaria subulata*: conidia and conidiophores from holotype (IMI 117496b). Bar = 50 μm.

as the conidium body enlarges. Largest conidia are 35-50 x 10-13 µm, dilute yellowish tan, smooth, with 4-5 transverse septa and rarely 1 longitudinal septum in one transverse segment, and with a narrow but not truly filiform beak up to 50-65 x ca. 4 µm. There is no evidence of secondary sporulation in either field specimen known for this taxon.

Holotype IMI 117496b is a portion of a specimen collected by D. Shaw and W. Burnett (Terr. Papua and New Guinea Dept. Agr. 4887) on leaf spots of *Euphorbia hirta*, S. Staines, Gusap, New Guinea, 20 January 1966. A second representative of the species in IMI 61966 (EGS 22-051) was collected by B. Beshir (Sudan Mycol. Herb. 2793) on the same host species, Zalingei, Sudan, 22 October 1955.

103. *Alternaria acalyphicola* Simmons Fig. 81

A second *Alternaria* on an *Acalypha* species was sent to me in 1985 as a culture from IMI. It is distinctly different not only from *A. acalyphae* (Nelen) Simmons (Alt.T&V 87 above) but also from any other *Alternaria* taxon described from a euphorbiaceous substrate.

Alternaria acalyphicola E. Simmons, sp. nov.

Ex cultura in agaro PCA descripta. Conidiophora simplicia vel ramosa, geniculata, dilute castanea, 65-100 x 5-7 µm. Conidia solitaria, raro in catenis bisporis, juventute anguste ovoidea, copiose pustulate vel tuberculate exasperata, maturitate punctulata, longe ovoidea vel ellipsoidea, dilute castanea, usque ad 75-80 x 18-20(-22) µm, rostro inramoso filamentoso 100-175 x ca. 2 µm, transverse 8-10 et longitudine ca. 5-7 septata. Habitatio typi in Acalypha indica L., Seychelles. Holotypus: pars ex cultura EGS 38-100 desiccata et in BPI conservanda.

Juvenile conidia usually are totally pustulate- or tuberculate-roughened, the ornamentation nearly obscuring a view of initial transverse septa. They commonly are ca. 40-45 x 10-14 µm with 5-6 transepta when a narrow apical beak begins to develop. The pustules become less crowded and decreasingly prominent as the spore body enlarges, as though they were being moved apart and pulled flat when the wall surface area increases. Some fully developed conidia may retain a scattering of pustules, but usually the mature surface is only punctulate, not prominently ornamented.

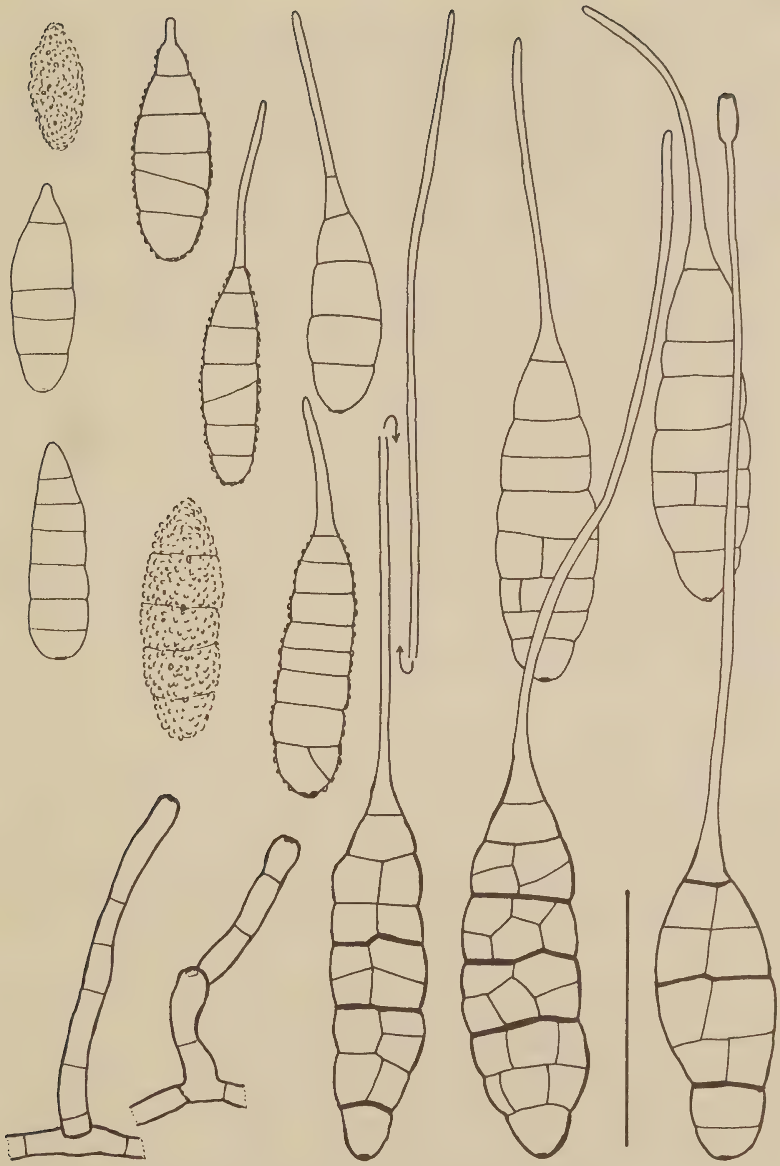

Fig. 81. *Alternaria acalyphicola*: conidia and conidiophores from holotype (BPI, EGS 38-100); all juvenile conidia densely ornamented, largest conidia almost smooth. Bar = 50 μm.

The spore bodies of fully developed conidia commonly reach a size range of 70-85 x 18-20(-22) μm plus a filamentous, unbranched beak 100-175 x ca. 2 μm. Largest conidia have 8-10 transverse septa and 1-2 longitudinal or variously oblique secondary septa in 5-7 of the transverse segments; they are a dilute chestnut brown in color with darker septa. Evidence of secondary sporulation is rare, usually in the form of a 1-cell, perforate swelling at the tip of a primary beak.

The holotype was prepared following reisolation from a culture received 10 May 1985 as IMI 266969 *Alternaria* sp., ex *Acalypha indica*, Seychelles.

104. *Alternaria heveae* Simmons Fig. 82

Two collections of *Hevea brasiliensis* leaves, gathered a year apart in Mexico, bear sparse growth of a single *Alternaria* species. Conidia, though present on leaf lesions, are difficult to locate, possibly because their wall color is so dilute. The fungus is distinguishable from all other species on Euphorbiaceae treated here. It is presented as a new species, with hope that more abundant modern material suitable for isolation work will be found.

Alternaria heveae E. Simmons, sp. nov.

Ex specimine siccato descripta. Conidiophora simplicia, geniculata, 15-35 x 4-5 μm, subhyalina. Conidia solitaria vel brevicatenata, anguste ovoidea vel ovoidea, dilute ochracea, laevia, transverse 4-5 et longitudine 1-2 septata, 60-95(-110) x 12-20 μm (rostro incluso). Habitatio typi in maculo Hevea brasiliensis, El Palmar, Mexico. Holotypus: BPI 0445779 (EGS 41-087), leg. W. J. Martin, June 8, 1946.

Juvenile conidia are narrowly ovoid; the spore body retains this shape as it enlarges and produces a gradually narrowing, sturdy (not filamentous) apical beak. Conidia have 6-7 transverse septa without producing longitudinal septa, or 1 longitudinal or oblique septum may develop in 1-2 of the broadest transverse segments. The tip of some beaks develops into a functional but morphologically scarcely differentiated (slightly swollen, perforate) secondary conidiophore. Juvenile conidia are about 30-50 x 8-9 μm with 4-5 transverse septa before beak growth is evident. Largest conidia are 60-95(-110) x 12-20 μm, dilute yellow-tan, smooth.

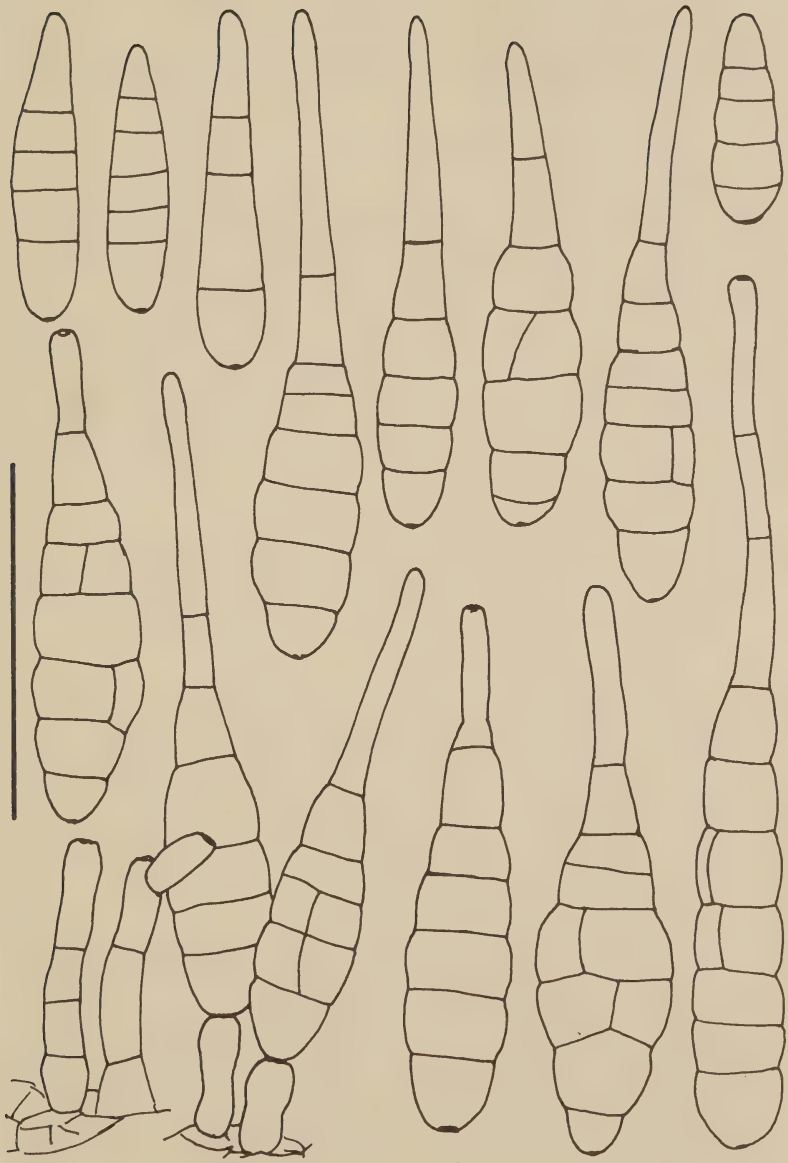

Fig. 82. *Alternaria heveae*: conidia and conidiophores from holotype (BPI 0445779). Bar = 50 μm.

Both the holotype BPI 0445779 and a second specimen of this taxon on *Hevea brasiliensis* were collected by W. J. Martin at El Palmar (Veracruz), Mexico, the holotype on June 8, 1946, and the second BPI 0445781 (EGS 41-089) in May 1947.

105. *Alternaria cicina* Simmons Fig. 83

Lesions in a collection of *Ricinus* leaves from Pakistan have growth of an *Alternaria* species that brings to mind some of the small, essentially beakless conidia of taxa discussed in the first paper of this Alt.T&V series, e.g., *A. mouchaccae* E. Simmons (1981). Similar, probably conspecific conidia occur also on a *Ricinus* leaf collection from Northern Rhodesia (Zambia). In lieu of cultures, which are of special value when characterizing relatively small-spored *Alternaria* taxa, this fungus is described as novel on the basis of field material produced under tropical but otherwise undefined conditions.

Alternaria cicina E. Simmons, sp. nov.

Etym.: L. *cicinus*, adj. rel. to the castor-oil plant, fr. Gr. *kiki*, the castor-oil plant (fide Brown, 1956, who with Stearn, 1992, are our ever-present help in time of Latin need)

Ex specimine siccato descripta. Conidiophora simplicia vel ramosa et geniculata, dilute ochracea. Conidia solitaria vel brevicatenata, plerumque anguste vel late ovoidea, vel late ellipsoidea, erostrata, interdum obclavata, apice conidifero, usque ad 30-45 x 12-17 µm, parce ochraceo, laevia vel minute punctulata, transverse 5-8 et longitudine plurime septata. Habitatio typi in maculo folii Ricinus communis, Karachi, Pakistan. Holotypus: IMI 75883a (EGS 26-192), leg. Azmatullah Khan (468), January 1958.

Juvenile and mature conidia alike are mostly narrow- or broad-ovoid and beakless. Conidia may remain ovoid or broad-ellipsoid with a bluntly rounded apex, or individual conidia may elongate, taper somewhat distally, and produce a small, thin-walled 1-cell secondary conidiophore. Well-developed conidia are ca. 30-45 x 12-17 µm, with 5-8 complete or partial transverse septa and 1-2 longitudinal or variously oblique septa in most of the transverse segments. Conidium color is a medium tawny brown with darker septa; walls are smooth to minutely punctulate.

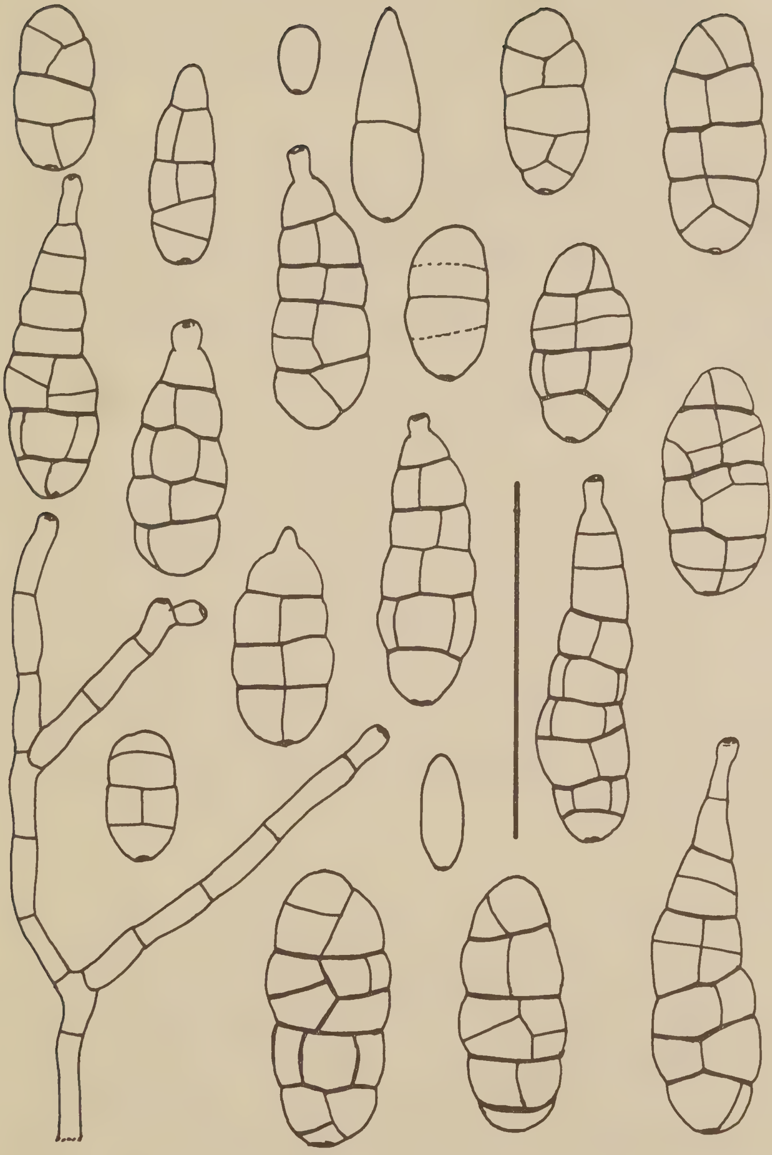

Fig. 83. *Alternaria cicina*: conidia and conidiophores from holotype (IMI 75883a). Bar = 50 μm.

Material similar to the holotype was collected on the same host species by A. Angus (434) at Mt. Mukulu Research Station, Northern Rhodesia, 7 February 1958 (IMI 75692, EGS 25-115).

A note on other herbarium specimens of Euphorbiaceae examined but not discussed above. This review has covered examination of approximately 130 isolates and field specimens purportedly of *Alternaria*, *Stemphylium* and somewhat similar genera. Most of the novel or otherwise remarkable taxa are included above. Many specimens contained *Alternaria* taxa of small-spored, chain-forming kinds that for the most part cannot be discussed profitably at present without using cultured isolates.

ACKNOWLEDGEMENTS

Dr. Mary E. Palm yet again has shown her support of this continuing series of *Alternaria* papers by providing professional encouragement as well as essential, critical, and much appreciated review of the prepublication manuscript. The several institutional herbaria and culture collections mentioned in the text have been generous with their loans and gifts of material for study. Dr. M. Aragaki, University of Hawaii, Honolulu, has shared some of his isolates from *Euphorbia pulcherrima*. Dr. K. Mortensen, Agriculture Canada, Regina, SK, Canada, with his continuing interest in pathogens of weedy spurges, has supplied the original isolates not only of *A. angustiovoidea* but also of the *A. agripestis* described herein as novel.

Key to *Alternaria* Taxa Known on Euphorbiaceae

Any key to *Alternaria* taxa now known from euphorbiaceous substrates will be inherently distorted, in that some of the species have been studied from natural collections, others from cultures, but from both in only about half the cases presented here. A good example of the hazard exists in *A. ricini*, whose conidium shape and ornamentation in culture are confusingly different from those observed in natural collections from which isolates were derived. In the following key a number preceding each epithet refers to an Alt.T&V treatment of each species.

Key: *Alternaria* Species on Euphorbiaceae

A. Beak narrowly filamentous. . . . . B/b
a. Beak sturdy-tapered, pseudorostrate or lacking . . J/j

  B. Beak unbranched. . . . . C/c
  b. Beak branched (sometimes rare) . . . . G/g

C. Conidia smooth (in nature) . . . . D/d
c. Conidia ornamented (in nature and/or culture). . . H/h

  D. Conidia catenate (in nature) . . . . E/e
  d. Conidia solitary (in nature) . . . . F/f

E. Transepta conspicuously constricting . . 100 *constricta*
e. Transepta only moderately constricting . . . 83 *ricini*

  F. Conidia ellipsoid to long ovoid. . 93,97 *euphorbiae*
  f. Conidia narrow ellipsoid . . . . . . 87 *acalyphae*

G. Beak branching rare (in nature). . . . . 87 *acalyphae*
g. Beak branching dominant, multiple. . . . 101 *agripestis*

  H. Conidia often catenate in culture. . . . 83 *ricini*
  h. Conidia rarely catenate in culture . . . . I/i

I. Ornamentation punctulate, becoming fine, obscurant in age. . . . . 98 *obtecta*
i. Ornamentation pustulate/tuberculate, becoming inconspicuous in age . . 103 *acalyphicola*

  J. Conidia solitary . . . . 102 *subulata*
  j. Conidia catenate . . . . K/k

K. Conidia strongly ornamented. . . . . 16 *angustiovoidea*
k. Conidia smooth in nature and in culture (if known). L/l

  L. Conidia erostrate or weakly pseudorostrate. . . . . 105 *cicina*
  l. Conidia erostrate or sturdily pseudorostrate . M/m

M. Erostrate conidium apex short, narrow-tapered. . . . . 15 *euphorbiicola*
m. Erostrate conidium apex long, sturdy-tapered. . . . . 104 *heveae*

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AGARICUS PSEUDOARGENTINUS N. SP. FROM ARGENTINA.

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Abstract: ***A. pseudoargentinus***, a new edible species found in the environs of Buenos Aires, is described and illustrated. It probably belongs to Section Sanguinolenti.

INTRODUCTION

During the Autumn months it is common to find in the environs of Buenos Aires a great diversity of species of *Agaricus*. They have been recorded by Spegazzini (1899, 1926), Martinez, (1949, 1957), Raithelhuber (1977, 1988) and Heinemann (1986, 1987, 1990).

Recently, specimens of a species that does not fit any described, were found and is here proposed as a new taxon.

MATERIALS AND METHODS

Specimens were studied both macro- and microscopically immediately after collection, annotating their colours according to the charts of Munsell [M] (1954) and Maerz and Paul [MP] (1930) and performing upon them the pertinent chemical reactions. The slenderness index (IG) as used by Heinemann (1983) is calculated as IG: L2/D.d, where L, D and d are stem length, pileus diameter and stem diameter, respectively.

Cultures were also made in the fresh condition by inoculating slant tubes containig potato-glucose agar (Ferri, 1985) with portions of the flesh. The abbreviation BAFC stands for the mycological herbarium of the above Department.

***Agaricus* pseudoargentinus** Albertó et Wright n. sp.

Pileo *usque ad 60-110 mm diam., primo globoso-haemispherico, dein convexo, fibrilloso vel fibrilloso-squamoso, squamulis obscuris densissimis ad disco centralis, fibrillis centralis obscuriorum, curtis, tenuis, delicatis, ad margo secedentibus; sub fibrillis niveo vel pallide brunneis, margo ab initio convoluto, integro, dein plano, appendiculato, breviter excedente supra lamellis. Superficies pileo ab hyphis hyalinis vel castaneis, cylindricis, 7-15 µm diam.* ***Stipite*** *40-130 x 10-20 mm, cylindraceus, niveus, fistulosus, fibrosus, in substrato parte basali rhizomorphis efformantibus.* ***Annulo*** *centrali vel superiori, simplex, membranaceo, descendente, pendulo niveo, persistente in maturitate.* ***Lamellis*** *liberis, confertis, ventricosis, acie integro, primo cinereis, dein pallide brunneis, in maturitate obscure brunneis. Pulvis sporarum obscure brunneis. Contexto ad centrum 10-17 mm, carni nivea. immutabilis, odori fungoso dulci, sapore grato. Edulis.*

Sporis: *4.7-5.7(6.5) x (3.2)3.70-4.2 µm curte ellipsoideis, brunneis, sine poris apicalis cum apiculo discernibile. Basidiis tetrasporis, claviformibus, 20-22 x 6-7 µm; sterigmatis curtis usque 3 µm long. Cheilocystidiis brunneis, late*

piriformibus vel globosis subglobosis, 16-25 x 09-14 µm .

React. Schaeffer: - ; KOH: - ; acido sulphurico: laeve; acido nitrico: laeve. Hab: solitario, sed abundantibus inter herbis, post pluvias.

Holotypus: Argentina, Bonariae, Burzaco, leg. E. Albertó. 2-V-1991, in Herb. BAFC nº 32.765 conservatus est.

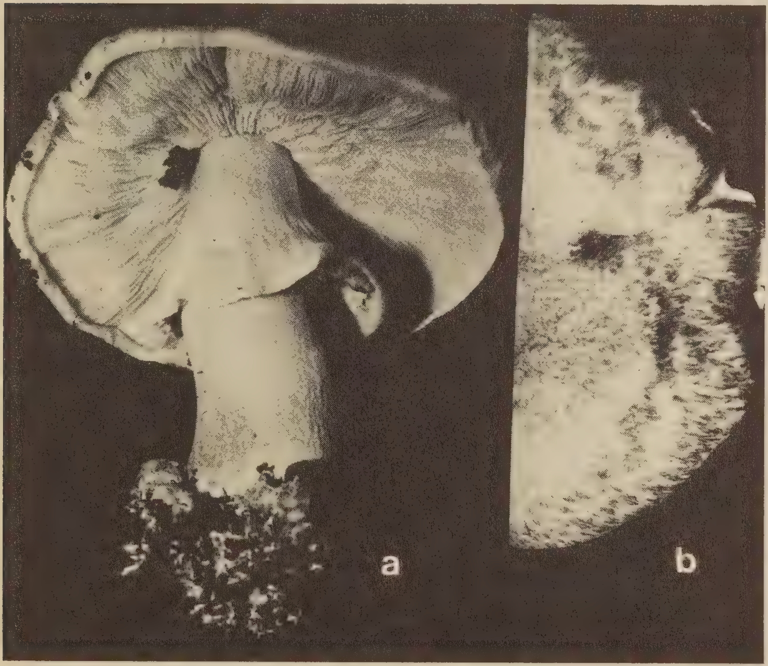

Fig.1: ***A.pseudoargentinus*** n. sp. **a-** Habit. **b-** Detail of the pileus surface showing the brown fibrils.

Pileus 60-110 mm diam., when young globose-hemispheric, later convex, with abundant brown to dark brown fibrils or fibrosquamules (10YR 6/6 [M]) with a darker central disk due to a higher density of fibrils, which are then shorter, thinner and more delicate, later separating towards the margin, and becoming longer and thicker (Fig. 1b),between white or tea-and-milk colour (11 C/5 [MP]); margin at first convolute and smooth, later plane, appendiculate, entire, slightly exceeding the lamellae. **Stipe** 40-130 x 10-20 mm, cylindric, white, sometimes with a brownish hue at the base, hollow, fibrous, forming rhizomorphs at the base inside the substrate. **Annulus** central or superior, simple, membranous, and descending, pendulous, skirt-like, white, persistent at maturity (Fig. 1a). **Lamellae** free, crowded, ventricose, with smooth edges, at first white to greyish, later tea-and-milk coloured, passing through sepia and finally dark brown. Spore print dark brown (56 J/2), difficult to obtain. **Context** in the centre of fruit-body 10-17 mm thick, white, unchangeable; odour mild, slightly fungous; taste pleasant, similar to *A.bisporus*. Edible.

Spores: 4.7-5.7(6.5) x (3.2)3.70-4.2 µm (Q:1.25-1.45) n= 30 shortly elliptic, smooth, brown, without an apical pore and with a visible apiculus. Basidia 4-spored, clavate, 20-22 x 6-7 µm; sterigmata short, up to 3 µm long. **Cheilocystidia**: hyaline to brown, widely pyriform or subglobose, 16-25 x 09-14 µm (Fig.2).

Pileus covering of hyaline and brown, cylindric hyphae, 7-15 µm diam.

Aspect slender, IG: 2.7-8.5 (Heinemann, 1983). Reactions: Schaeffer:- ; KOH:- ; Sulphuric acid: slight; Nitric acid: slight pinkish.

Solitary but abundant, outside the woods, among grass in lawns, after rains.

Exsiccatum: Pileus light brown with dark brown fibrils (15 J11 [MP]). Lamellae brown with white efflorescence present. Stipe light brown

(10 D6 [MP]) yellowish at the base (11 F6 [MP]).

Material studied: Buenos Aires City, Nuñez, leg. D. Cabral, 02-V-91 (BAFC: 32.334); Buenos Aires, Burzaco, leg. E. Albertó, 02-X-91 (BAFC: 32.726) and 12-XI-91 (Holotypus: BAFC: 32.765).

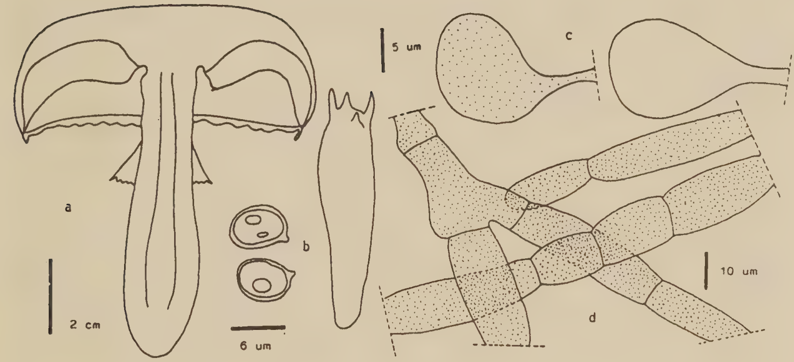

Fig. 2: a- Longitudinal section of fruit body. **b**- spores and basidium, **c**- Cheilocystidia, **d**- hyphae of pileus covering.

REMARKS

The specimens studied are similar to *A.argentinus* Speg.(1889) as to pileus and general aspect , which Spegazzini illustrated with a photograph in a later work (Spegazzini, 1926), but they differ in the following features: i- Spore print. A curious feature is the difficulty in obtaining one, both in young and mature specimens of ***A.pseudoargentinus***, whereas in *A. argentinus* (Holotypus LPS 15.454 reduced to a spore print) and later collections by Lindquist, 10-V-1938 (LPS 15.458) and Argentino Martinez, 20-IX-1939 (LPS 15.457), the spore-print is abundant and, furthermore of a very characteristic reddish ferrugineous colour (almost as iron oxide); ii- Additionally, Spegazzini (op. cit.) indicates for *A.argentinus* a double ring and a solid stipe. This contrasts with the simple ring and fistulose stipe of ***A.pseudoargentinus***.

Following Heinemann (1962), *A.argentinus* pertains to Sect. *Agaricus* (Campestres). The same author (pers. comm) believes that ***A.pseudoargentinus*** must tentatively be assigned to Sect. Sanguinolenti (Möller et Schaeffer) Singer.

Within Sect. Sanguinolenti, ***A.pseudoargentinus*** is close to *A.impudicus* (Rea) Pilat and *A.lanipes* (Möller et Schaeffer) Singer. *Agaricus impudicus* differs by its smooth pileus when young, later, when mature, by its pinkish to dark brown pileus, with a large and smooth central disk. Furthermore, it may have membranous residues of the fugacious general veil, and the flesh is faintly pinkish at the stem apex. Its odour is disagreeable, similar to that of *Lepiota cristata*. Spores are slightly wider, cheilocystidia are slightly wider and hyaline. The species is gregarious and grows in *Picea* woods.

Agaricus lanipes, differs by the chocolate brown cuticule (sometimes tawny or ochraceous) of this species, which remains for a long time uncracked and, consequently, does not exhibit fibrillose squamules from the early stages, although at later stages it may appear torn into fibrillose scales and adpressed fibrils and show the white flesh undernearth (Capelli 1984). However, the central disk usually remains smooth or rugose-smooth; the stem is 40-80 mm long and 25-33 mm thick, being rather short and clavate. According to Möller (1950), the Schaeffer reaction is usually negative but positive in the yellowish areas of the stem. The flesh is whitish varying to "apricot yellow" towards the base and sometimes yellowish red towards the apex. Its spores are slightly larger in both dimensions. It grows in broadleaved woods, mainly of *Quercus ilex*.

Agaricus fuscofibrillosus differs by its hazel-brown cap cuticle, densely fibrillose except at the disc; the stem is relatively slender, almost perfectly cylindrical and flesh turning red on cutting. The ring is simple but narrow and fragile. *A. fuscofibrillosus* is a wood inhabiting-species, Capelli,(op cit.) only found it in the Boscone della Mesola under *Quercus ilex*.

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Drs P. Heinemann (Gembloux) and Roy Halling (NY) read the original typescript and made invaluable suggestions for which we thank them most heartily. We also thank Mons. J. P. Macarone for the Latin revision.

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THREE NEW SOUTHAMERICAN SPECIES OF BOVISTA

(GASTEROMYCETES)

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Summary

Bovista fuegiana, B. singeri and B. sublaevispora are reported as new species from Southern South America, recorded from Tierra del Fuego, Argentina, Nor-Yungas, Bolivia and Viña del Mar, Chile, respectively.

During a survey of the Austroamerican Lycoperdales, several collections pertaining to the genus Bovista Pers.: Pers. that did not match any of the described species (cfr. Coker & Couch, 1928; Wright, 1949; Smarda, 1958; Kreisel, 1967; Calonge & Demoulin, 1975; Jülich, 1984; Ortega & Buendía, 1985, 1989) were studied.

For this reason we have decided to propose them as new species.

Materials and methods

For the study of the fruitbodies of these species the procedure followed is identical to that given earlier (Wright & Suárez, 1990). We added two methods, suggested by Drs. V. Demoulin and O. K. Miller, respectively:1) soaking the material in ETOH 95%, then water, and mounting in 3% KOH + Congo Red, and 2) boiling the sections (under the cover slip) in chloral hydrate (twice the amount of chloral to that of water). Colours are annotated according to Maerz & Paul (1930), indicated as MP. Herbarium abbreviations are according to Holmgren, Holmgren & Barnett (1991).

Bovista fuegiana Suárez & Wright n. sp. (Figs. 1-4; 13)

Gastrocarpo globoso, 2.7-3 cm diam., brunneo, rhizomorpho absens. Peridio fragile, in duos stratos: exoperidio brunneo, laevi, furfuraceo, endoperidio spadiceo. Dehiscentia ignota. Gleba brunneo-viridi. pulveracea. Subgleba com pacta, 4-5 mm alt.

Exoperidio pseudoparenchymatico, cellulis 10-31 x 16-50 µm. Endoperidio ab hyphis parallelis, juxtapositis, indistinctis. Sporis globosis pallide brunneis, valde verrucosis sub lente; sub microscopio electronico dense verrucosis, verrucis rotundatis majores et minores, 5.5-6.5 µm. Capillitio transitionis, pallide brunneo, poris numerosis usque ad 1 µm diam., sine trabes, ramis principalis 5-8 µm diam.

In pratis sub Berberis prope sylvam. Holotypus: Argentina, Fuegiae, Ushuaia, leg. Wright & Del Busto nº 2180, 3. II.1973, in Herb. BAFC nº 32210 conservatus est.

Fruitbody globose (Fig. 1), 27-30 mm diam., brown, without a rhizomorph. Peridium fragile, formed by a brown exoperidium (ca MP Pl 8 11-12 J-L), smooth-furfuraceous, and a "beige" endoperidium (ca MP Pl 14 8 E-F). Dehiscence not observed due to the material being torn. Gleba greenish-brown, powdery. Subgleba compact, 4-5 mm high.

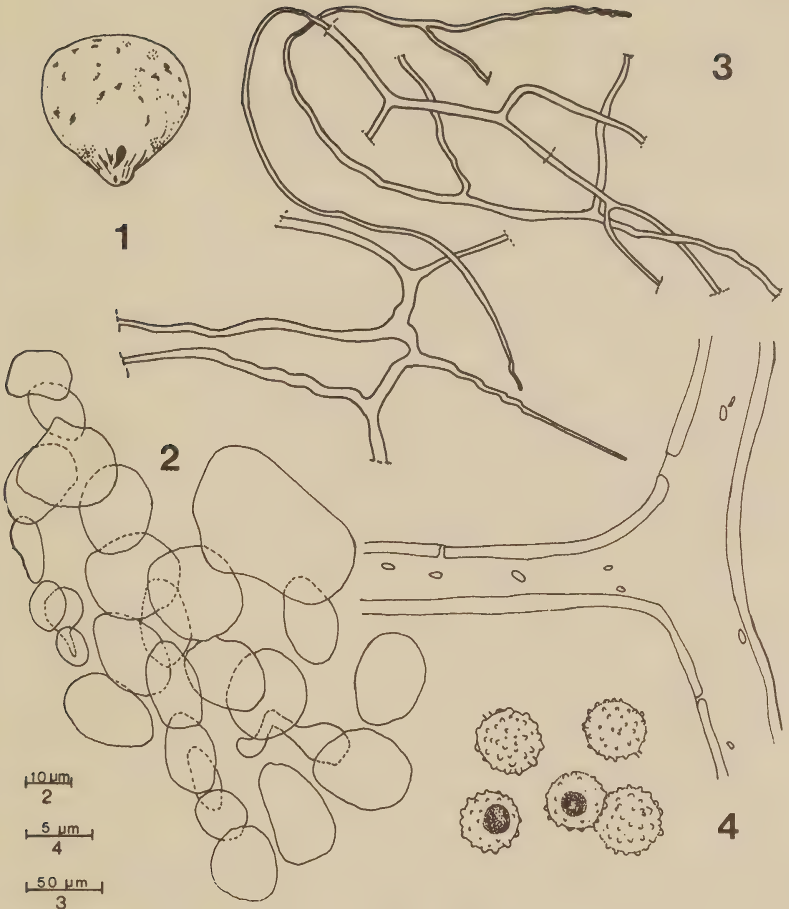
Endoperidium (Fig. 2) formed mainly by pseudoparenchymatic cells, 10-31 x 16-50 µm diam. Endoperidium formed by juxtaposed parallel hyphae, difficult to measure. Spores globose, light brown, strongly ornamented, appearing verrucose and without pedicels under LM (Fig. 4); under SEM the ornamentation is seen as densely arranged, capitate warts and among them, much smaller ones; with conspicuous pedicels (Fig. 13); 5.5-6.5 µm diam. Capillitium (Fig 3-4) of the "transition" type, light brown, with numerous pores, distributed in principal branches and intermediate branches, up to 1 µm diam., without septa; principal branches 5-8 µm diam., intermediate ones 3-4.8 µm, tapering to a fine point less than 1-1.8 µm diam.

Habitat: in prairies with Berberis, just outside the forest.

Distribution: Argentina, Tierra del Fuego.

Material studied: the holotype.

Remarks: The present species is characterized by having a "transition" type capillitium with pores, and very ornamented spores, without pedicels, under LM. It is close to Bovista aestivalis (Bon.) var. perverrucispora Ortega & Buendía (Ortega & Buendía, 1989), but differs in the smaller size of the spores (3.5-4.2 µm diam.), the less crowded ornamentation under SEM of the latter, and also with conspicuous pedicels. Kreisel (1967) records B. aestivalis under B. polymorpha (Vitt.)Kreisel. In this author's key to the species of Bovista, our species would key out as a member of subgenus Globaria, Ser. Polymorphae



Figs. 1-4. Bovista fuegiana Suárez & Wright n.sp. 1: General aspect of gastrocarp, ca. 1 x. 2: Pseudoparenchymatic cells of the exoperidium. 3: Transition-type of capillitium. 4: Spores and capillitium under LM.

leading through the features of its exoperidium and the presence of a gleba to B. aenea Kreisel (UPS!) which, however, has smaller spores (3.5-4 µm) and exoperidium (15-27 x 11-19 µm).

According to V. Demoulin (pers. comm.) it might also be close to B. cunninghami Kreisel (Kreisel, 1967) (PDD!), which was described from Australia on the basis of a single fruitbody. This appears to be a species with imperfectly known variability. B. fuegiana differs from it, however, by having: i) a distinct sterile base, ii) grossly ornamented spores, iii) a much larger fruitbody, and iv) a brown furfuraceous exoperidium, whereas B. cunninghami was described as lacking a sterile base, having a pseudorrhiza, smooth spores, a fruitbody of 13 cm diam. and a grumous whitish exoperidium.

Bovista singeri Suárez & Wright n. sp. (Figs. 5!8; 14)

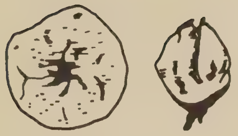
Gastrocarpo parvo, 8–13 mm diam., globoso-depresso, brunneo, absque rhizomorpho vel parve evoluto. Exoperidio tenui, ephemero, verrucis minutis fuscatibus exornato. Endoperidio tenui, papyraceo, laevi, sapiceo, ab pori apicalibus regulari dehiscente. Gleba brunneo viridi, pulveraceacea. Subgleba absens.

Exoperidio vesiculoso, sphaerocystis 12–27 x 16–41 µm. Endoperidio membranaceo, ab hyphis curtis tenuitunicatis hyalinis efformantibus, 1.8–5.4 µm diam., aliquot pseudoparietibus exornatis, alieae ramificationes dichotomicas efformantibus. Sporis ovoideis, pallide brunneis, verrucosis sub lente, uniguttulatis, apedicellatis vel mucronatis sub microscopio electronico verrucis cylindricis, aggregatis, confluentibus vel anastomosantibus. Capillitio typo Lycoperdon, pallide brunneo, poris .32 µm diam., sine trabes, ramificatione dichotomicis, 1–5 µm diam. Holotypus: ad foliiis putrefactis in sylvis, alt. 1450 m, BOLIVIA, Dept° La Paz, Prov. Nor-Yungas, Charobamba, leg. R. Singer n° 1129, 13.II.1956, In Herb. BAFC n° 31411 conservatus est. Ad Cl. mycologo Rolf Singer dicatus est.

Fruitbody small (Fig. 5), 8-13 mm diam., globose-depressed, brown, rhizomorph absent or hardly developed. Exoperidium thin, ephemerous, with minute dark verrucae. Endoperidium thin, papyraceous, smooth, "beige" (ca MP pl 13, 6 C-E; pl 14, 7 E-F). Dehiscence by a small, irregular, apical pore. Gleba olivaceous "beige", powdery. Subgleba absent.

Exoperidium (Fig. 6) vesiculose, formed by sphaerocysts 12-27 x 16-41 µm. Endoperidium membranous, formed by short thin-walled, hyaline hyphae, 1.8-5.4 µm diam., a few with

Figs. 5–8. Bovista singeri Suárez & Wright n. sp. 5: General aspect of gastrocarp, ca. 1 x. 6: long. section of the peridium with the pseudoparenchymatic cells and the hyphal structure of the endoperidium. 7: Lycoperdon-type of capillitium. 8: Spores and capillitium under LM.



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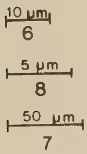
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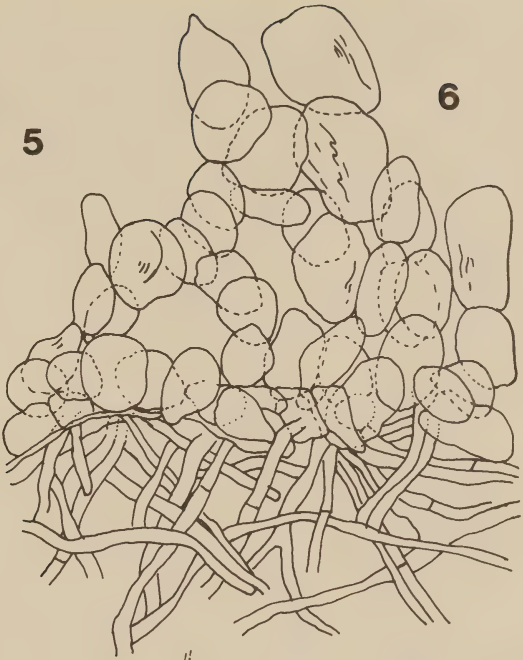

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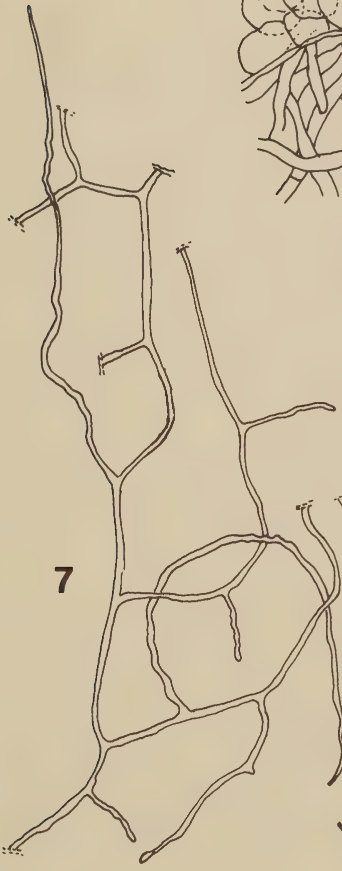

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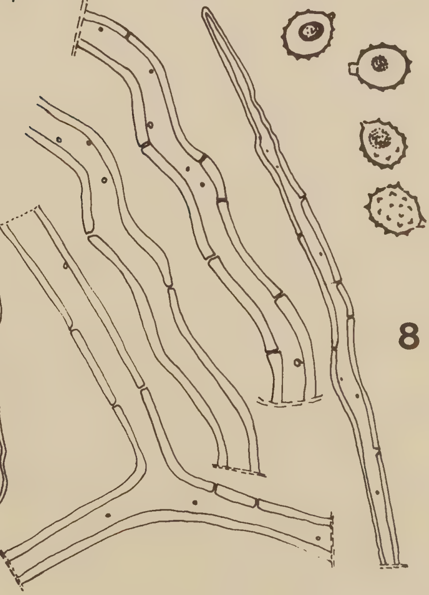

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pseudowalls and a few others with dichotomous branching. Spores ovoid, never globose, brown, strongly ornamented; under LM they appear verrucose, uniguttulate, without pedicels, with very short mucros (Fig. 8); 3.2-3.6 x 3.6-4.3 µm; under SEM the ornamentation appears as somewhat crowded, cylindric verrucae which are nearly free or confluent united by low connective threads; a short, broken pedicel is obvious (Fig. 14). Capillitium (Figs. 7-8) of the *Lycoperdon*-type, light brown, with pores ca .3 µm diam., *uniformly* distributed along the branches, without septa, branching dichotomous, Y-shaped, fairly flexuous, uniform *in* size, 1-5 µm diam., extremities 1-1.4 µm diam.

Habitat: on plant debris in the rain forest, alt. 1450 m.

Distribution: Bolivia.

Material studied: The holotype.

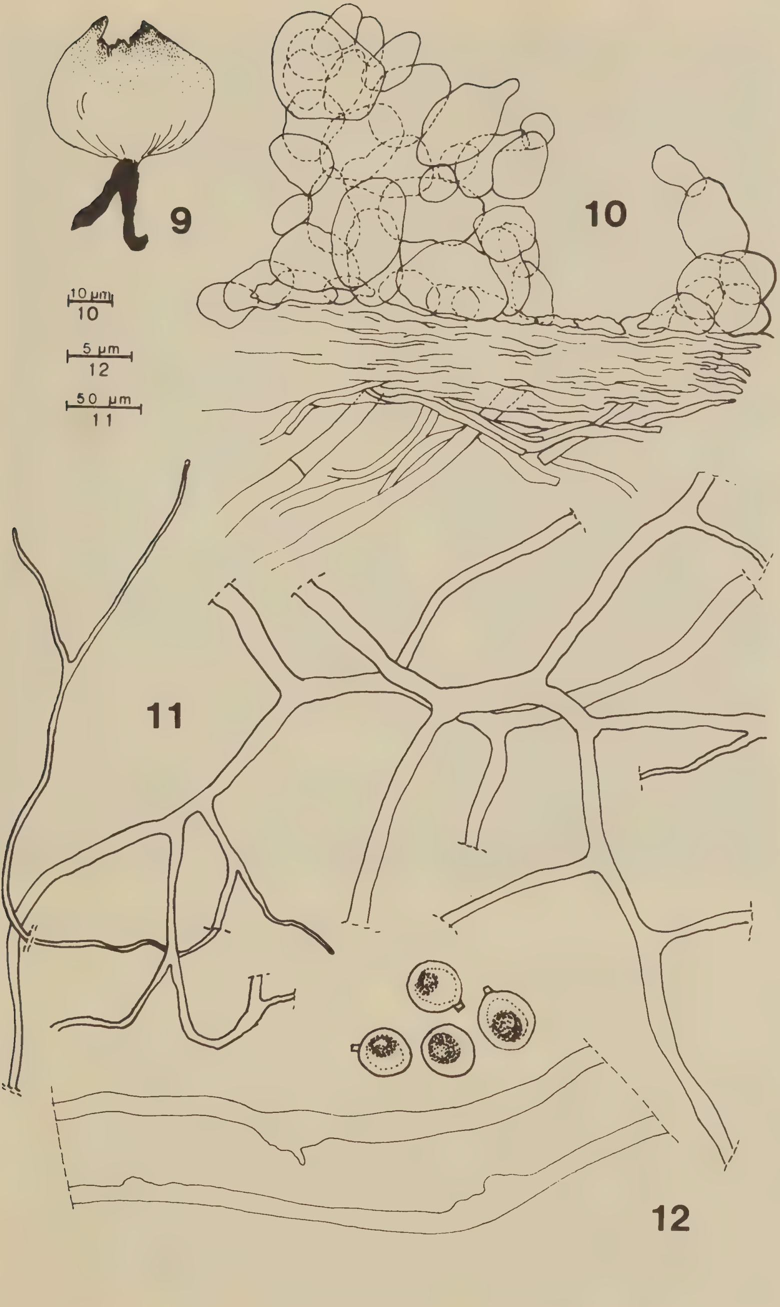
Remarks: This is characterized by having a *Lycoperdon-type capillitium* with pores, and very *ornamented, ovoid* spores without pedicels under LM. It is close to *B. glacialis* Kreisel (M!), *B. dermoxantha* (Vitt.)De *Toni, and B. delicata* Berk. & *Curt. (PC!); the* former two, however, *have globose* spores, although also strongly ornamented; the latter has also globose though hardly ornamented spores. Unfortunately, the collector did not give more accurate information concerning the locality or the ecology of the species.

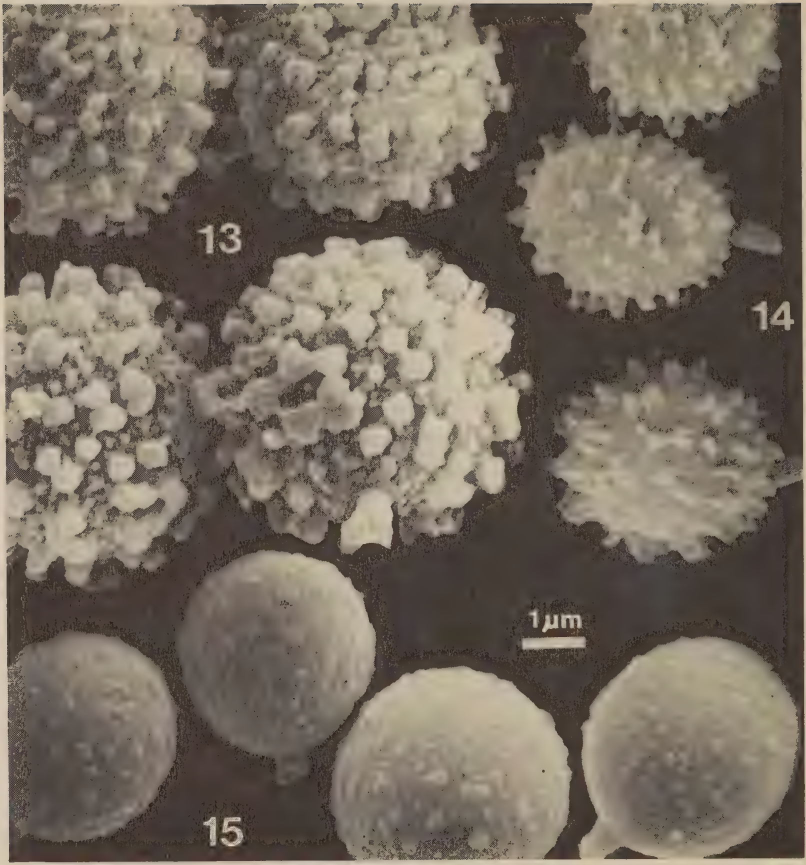
According to V. Demoulin (pers. comm.), *B. singeri* might be close to *B. oblongispora* Villiers *et al. (1989)*, however distinct it *may be. We believe* the differences between these two species are so obvious to warrant their separation, for *B. oblongisporum* has: i) a conspicuous cord of mycelial *threads, ii) a capillitium* of the "intermediate" type, iii) larger spores, with different ornamentation under SEM and iv) generally long spore-pedicels, none of which features can be found in *B. singeri*.

Bovista sublaevispora Suárez & Wright n. sp.
(Figs. 9-12; 15)

Gastrocarpo subgloboso, ca 30 mm diam., brunneo-aeneo minute punctato, rhizomorpho bene evoluto. Peridio tenui,

Figs. 9-12. *Bovista sublaevispora* Suárez & Wright n. sp. 9: General *aspect of gastrocarp*, ca 1 x. 10: long. section of the peridium with the pseudoparenchymatic cells of the exoperidium and the compact hyphal structure of the endoperidium. 11: *Bovista-type* of capillitium. 12: Spores and capillitium under LM.


10 µm
5 µm
50 µm



Figs. 13–15. Photomicrographs of spores under SEM. 13: *Bovista fuegiana* (Holotype). 14: *B. singeri* (Holotype). 15: *B. sublaevispora* (Holotype).

papyraceo, duplo. Exoperidio tenui, verrucoso, verrucis rotundatis vel conicis, fuscis, dense aggregatis. Endoperidio papyraceo, aeneo, ab poro apicali irregularibus dehiscens. Gleba pallide brunnea vel flavae,pulverulenta. Subgleba minuta, compacta. Endoperidio pseudoparenchymatico, cellulis verrucis 9–29 x 13–43 µm, basis strato amorpho vel pseudoparenchymatico fatiscentibus. Endoperidio papyraceo, hyphis parallelis juxtapositis instructis, subter hyphis hyalinis tenuitunicatis, 1.5–4 µm diam. Sporis globosis vel subglobosis, apedicellatis, sub microscopio

electronico verrucis minutis, rotundatis, 3.4-5 µm diam. Capillitio typo *Bovista*, brunneo, sine poris, trabes absens, ramis dichotomicis, ramis principalis 7-32 µm diam. *Holotypus:* CHILE, Viña del Mar, Horto Botanico, leg. anon. 28.II.1966, in Herb. BAFC nº 32211 conservatus est.

Fruitbody subglobose (Fig. 9), ca 30 mm diam., light brilliant bronze, with minute dark and densely arranged punctuations; rhizomorph well developed. Peridium thin, papyraceous. Exoperidium, thin, under LM blunt to conic, dark, densely arranged verrucae can be observed. Endoperidium papyraceous, bronze-coloured (ca MP pl 15, 9-10 C-E), smooth. Dehiscence through an irregular apical aperture. Gleba light brown to yellowish, powdery. Subgleba very small, compact, probably not sufficiently mature.

Exoperidium entirely pseudoparenchymatic, the verrucae formed by cells ca 9-29 x 13-43 µm; the base is an amorphous layer which in some sections suggests having also been formed by pseudoparenchymatic cells which have disintegrated (Fig. 10)). Endoperidium (Fig. 10) papyraceous, formed by juxtaposed parallel hyphae which are difficult to measure, followed by thin-walled hyaline hyphae, some with false septa, 1.5-4 µm diam. Spores almost smooth, uniguttulate, without pedicels (Fig. 12); under SEM the ornamentation appears as incipient blunt verrucae not densely arranged and without any sort of connections between them (Fig. 15), 3.5-5 µm diam. Capillitium (Figs. 11-12) *Bovista*-type brown, without pores nor septa nor pseudosepta, branching dichotomous, principal branches ca 7-31 µm diam., terminal branches ca 1-1.5(-2) µm, the units being flexuous, each exceeding a microscopic field.

Habitat: no data.

Distribution: Chile.

Material studied: the holotype.

Remarks; This species is characterized by having a *Bovista*-type capillitium without pores, and globose, almost smooth spores, which appear slightly verrucose under SEM and without pedicels. It is close to *B. fulva* Mass. (K!), which has subglobose spores but with long pedicels. The latter species belongs to the group of species remaining attached to the substratum (Subgenus *Bovista*, Sect. *Nannobovista*, Ser. Fuscae, according to Kreisel (1967), but we have no information concerning this feature in our species other than the presence of a conspicuous rhizomorph at its base. Furthermore, the new species does not have a "furfuraceous-areolate" exoperidium, and its cells are much smaller than in *B. fulva* (4-7.5 µm diam.).

According to V. Demoulin (pers. comm.), B. sublaevispora might be mistaken with B. coprophila (Cke. & Mass.)G. H. Cunningh. (K!), but the spore ornamentation of both species under SEM is entirely different. Furthermore, the diameter of the capillitium in B. sublaevispora is wider (31 µm) than that recorded for B. coprophila (23 µm).

Acknowledgements

We wish to thank Drs. Orson K. Miller (Virginia Polytechnic Institute) and Vincent Demoulin (Liège), for critically reading the typescript and making many valuable suggestions.

Keepers of the K, M, PC, UPS, PDD and LPS herbaria are gratefully acknowledged for the loan of type materials in their keeping.

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FOUR NEW SPECIES IN THE LICHEN GENUS PARMELIA (ASCOMYCOTINA, LECANORALES) FROM SOUTHERN AFRICA, WITH NOTES ON SOUTHERN AFRICAN LICHENS*

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ABSTRACT

Four new species in the lichen genus *Parmelia* (Parmeliaceae, Ascomycotina) are described from southern Africa. They are: *Parmelia chionophila* Brusse, *P. emolumenta* Brusse, *P. mesmerizans* Brusse and *P. supposita* Brusse. One new combination is made: *Parmelia protoquintaria* (Hale) Brusse. Notes on several species are provided.

NEW SPECIES

Parmelia chionophila Brusse, *sp. nov.* Fig. 3.

Thallus foliosus, saxicolus, usque ad 7 cm diam., arcte adnatus. *Lobi* elongati, 0.5 - 2.5 mm lati, 100 - 350 μm crassi. *Thallus superne* flavo-viridis, hebetatus, isidiis sorediisque destitutus; epicortice rudimentali. *Cortex superior* 9 - 20 μm crassus. *Stratum gonidiale* 30 - 90 μm crassum, algis *Trebouxiis*. *Medulla* albida, 50 - 230 μm crassa. *Cortex inferior* 6 - 12 μm crassus. *Thallus inferne* pallide brunneus, sat rhizinatus. *Rhizinae* simplices, parvae, ad 0.3 mm longae, prope basin 25 - 70 μm crassae. *Apothecia* adnata, usque ad 2 mm diam., discis atris, subnitidis. *Hypothecium* hyalinum, 30 - 40 μm crassum, J-. *Subhymenium* hyalinum, 20 - 30 μm crassum, J+ pallide caeruleum. *Epihymenium* pallide badium, N+ fugace cyaneum. *Hymenium* hyalinum, 50 - 60 μm altum, J+ caeruleum. *Asci* clavati, cum tholis J+ caeruleis (fig. 1). *Ascosporae* non visae. *Pycnidia* hyalina, globosa, circa 100 μm diam. *Spermatia* acicularia, hyalina, recta, 7.5 - 15.5 X 0.7 μm. *Thallus* acidum usnicum, acidum hyposticticum, acidum hyposalazinicum, et acidum hypoconsticticum continens.

TYPUS: SOUTH AFRICA, CAPE PROVINCE - **3319** (Worcester):

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* This contribution is dedicated in memory of the late **Dr. Ove Almborn (Lund)**, an enthusiastic student of southern African lichens, in recognition of his work on foliose and fruticose Teloschistaceae, and in gratitude for all his efforts towards a Lichen Flora of southern Africa.

-BC (De Doorns) Hex River Mountains. Summit of Matroos Mountain, near De Doorns. On SE sloped face of Table Mountain Sandstone outcrop on SE slope with no cliffs nearby. Hex River Valley clearly visible from here. Alt. 2240 m. *F. Brusse 6166*, 28. xi. 1991 (**PRE**, holo-; **BM**, **LD**, **UPS**, iso-). Figura 3.

Thallus foliose, saxicolous, up to 7 cm across, tightly adnate. *Lobes* elongate, 0.5 - 2.5 mm broad, 100 - 350 μm thick. *Upper surface* yellow-green, matt, neither isidiate nor sorediate; epicortex rudimentary. *Upper cortex* 9 - 20 μm thick. *Algal layer* 30 - 90 μm thick, algae *Trebouxia*. *Medulla* whitish, 50 - 230 μm thick. *Lower cortex* 6 - 12 μm thick. *Lower surface* pale brown, darkening towards the lobe tips and margins, moderately rhizinate. *Rhizines* simple, small, to 0.3 mm long, 25 - 70 μm thick near base. *Apothecia* adnate, up to 2 mm across, disc black, subglossy. *Hypothecium* hyaline, 30 - 40 μm thick, J-. *Subhymenium* hyaline, 20 - 30 μm thick, J+ pale blue. *Epihymenium* toffee brown, N+ fleeting blue. *Hymenium* hyaline, 50 - 60 μm high, J+ blue. *Asci* clavate; tholus J+ blue (fig. 1). *Ascospores* not seen. *Pycnidia* hyaline, globose, *ca.* 100 μm diam. *Spermatia* hyaline, straight, needles, 7.5 - 15.5 X 0.7 μm. *Chemistry*: usnic, hypostictic, hyposalazinic, and hypoconstictic acids present.

Etymology: *chion* (G) = snow; *philos* (G) = loving; alluding to the relatively large amount of snow that falls at the type locality. Due to this fact, this is a favourite spot for local skiers.

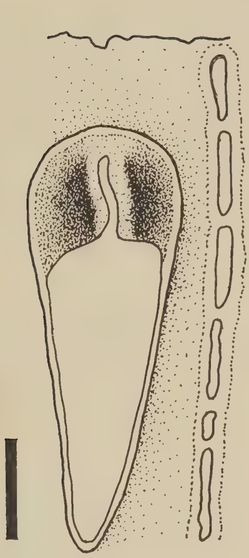
This new species resembles the Australian *Parmelia subcrustacea* Gyeln. (Elix 1981), but is clearly distinguished from it by the N+ fleeting blue epihymenium, which is in contrast to the N- epihymenium of the latter. *Parmelia chionophila* also becomes coarse-pruinose towards the tips of the lobes, and lacks a coherent epicortex. *P. subcrustacea*, on the other hand, becomes more glossy towards the lobe tips and possesses a pored epicortex. The N+ fleeting blue epihymenial reaction which was discussed in detail by Brusse (1993), is present in many effigurate-crustose brown Parmeliae and in several lichens assigned to *Karoowia* by Hale (1989b), including the type, *P. adhaerens* Nyl. *P. chionophila* is the largest and most foliose lichen found so far, with the N+ fleeting blue epihymenial reaction.

Thus far this new species has been discovered only at the type locality, Matroos Mountain the highest peak in the Hex River Mountains, near De Doorns.

Parmelia emolumenta Brusse, *sp. nov.* Fig. 4.

Thallus foliosus, saxicolus, usque ad 5 cm diam., arctissime adnatus. *Lobi* elongati, 0.2 - 1.5 mm lati, 150 - 700 μm crassi. *Thallus superne* flavoviridis, hebetatus vel apicem loborum versus grosse pruinosus, isidiis sorediisque destitutus; epicortice rudimentali. *Cortex superior* circa 20 μm crassus. *Stratum gonidiale* 25 - 140 μm crassum, algis *Trebouxiis*. *Medulla* albida, 70 - 600 μm crassa. *Cortex inferior* 10 - 15 μm crassus. *Thallus inferne* pallide brunneus. *Rhizinae* non bene evolutae. *Apothecia* (immatura tantum visa) ad 1 mm diam., adnata. *Epihymenium* pallide badium, N+ fugace cyaneum. *Pycnidia* hyalina, globosa, circa 120 μm diam. *Spermatia* acicularia, hyalina, recta, 5.5 - 8.0 X 0.7 μm. *Thallus* acidum usnicum, acidum sticticum, acidum consticticum et acidum norsticticum (min.) continens.

TYPUS: SOUTH AFRICA, CAPE PROVINCE - **3319** (Worcester): **-BC** (De Doorns) Hex River Mountains. Summit of Matroos Mountain, near



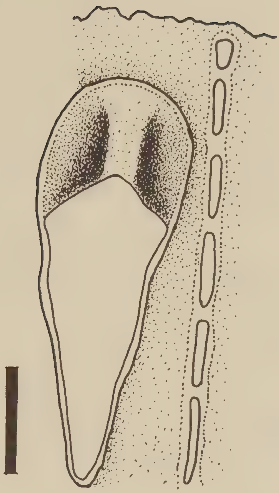


FIGURE 1. - *Parmelia chionophila* Brusse, ascus and paraphyses. *F. Brusse 6166*, holotype. Bar = 10 μm.
FIGURE 2. - *Parmelia supposita* Brusse, ascus and paraphyses. *F. Brusse 5496*, holotype. Bar = 10 μm.

De Doorns. On SE sloped face of Table Mountain Sandstone outcrop on SE slope with no cliffs nearby. Hex River Valley clearly visible from here. Alt. 2240 m. *F. Brusse 6165*, 28. xi. 1991 (**PRE**, holo-; **LD**, iso-). Figura 4.

Thallus foliose, saxicolous, up to 5 cm across, very tightly adnate. *Lobes* elongate, 0.2 - 1.5 mm broad, 150 - 700 μm thick. *Upper surface* yellow-green, matt to coarsely pruinose towards the lobe tips, both isidia and soredia lacking; epicortex rudimentary. *Upper cortex ca.* 20 μm thick. *Algal layer* 25 - 140 μm thick, algae *Trebouxia*. *Medulla* whitish, 70 - 600 μm thick. *Lower cortex* 10 - 15 μm thick. *Lower surface* pale brown, darkening towards the tips and margins. *Rhizines* poorly developed. *Apothecia* (only immatures seen) up to 1 mm across, adnate. *Epihymenium* toffee brown, N+ fleeting blue. *Pycnidia* hyaline, globose, *ca.* 120 μm diam. *Spermatia* hyaline, straight needles, 5.5 - 8.0 X 0.7 μm. *Chemistry*: usnic, stictic, constictic acids, and norstictic (min.) acids present.

Parmelia emolumenta is another new species with an N+ fleeting blue epihymenium. It otherwise seems similar to *Xanthoparmelia xanthomelanoides* Elix & Johnston a species with an N- epihymenium, and also a glossy pored-epicorticate upper surface. *P. emolumenta* lacks a coherent epicortex.

This new species is so far known only from the type locality, Matroos Mountain, near De Doorns.

Parmelia mesmerizans Brusse, *sp. nov.* Fig. 5.

Thallus foliosus, saxicolus, usque ad 7 cm diam., arctissime adnatus. *Lobi* elongati, 0.3 - 2.0 mm lati, 130 - 380 μm crassi. *Thallus superne* flavoviridis, hebetatus vel apicem loborum versus scabrosus, isidiis sorediisque destitutus; epicortice rudimentali. *Cortex superior* circa 20 μm crassus. *Stratum gonidiale* 30 - 100 μm crassum, algis *Trebouxiis*. *Medulla* albida, 60 - 270 μm crassa. *Cortex inferior* 8 - 12 μm crassus. *Thallus inferne* atro-brunneus vel piceus, sat rhizinatus. *Rhizinae* simplices, parvae, usque ad 150 μm longae, prope basin 45 - 150 μm crassae. *Apothecia* non visa. *Pycnidia* hyalina, globosa, circa 120 μm diam. *Spermatia* acicularia, hyalina, recta, 6.5 - 14.5 X 0.8 μm. *Thallus* acidum usnicum, acidum hyposticticum, acidum hyposalazinicum, et acidum hypoconsticticum continens.

TYPUS: SOUTH AFRICA, CAPE PROVINCE - **3319** (Worcester): **-BC** (De Doorns) Hex River Mountains. Summit of Matroos Mountain, near De Doorns. On level Table Mountain Sandstone pavement on SE slope, near summit. Full sun. Alt. 2230 m. *F. Brusse 6141*, 28. xi. 1991 (**PRE**, holo-; **LD**, iso-). Figura 5.

Thallus foliose, saxicolous, up to 7 cm across, very tightly adnate. *Lobes* elongate, 0.3 - 2.0 mm broad, 130 - 380 μm thick. *Upper surface* yellow-green, matt to scabrous towards the lobe tips, non-isidiate and non-sorediate; epicortex rudimentary. *Upper cortex ca.* 20 μm thick. *Algal layer* 30 - 100 μm thick, algae *Trebouxia*. *Medulla* whitish, 60 - 270 μm thick. *Lower cortex* 8 - 12 μm thick. *Lower surface* dark brown to black, becoming lighter brown towards the lobe tips. *Rhizines* simple, small, up to 150 μm long, 45 - 150 μm thick near base. *Apothecia* not seen. *Pycnidia* hyaline, globose, *ca.* 120 μm diam. *Spermatia* hyaline, straight needles, 6.5 - 14.5 X 0.8 μm. *Chemistry*: usnic, hypostictic, hyposalazinic, and hypoconstictic acids present.

This new species is closest to *Parmelia protoquintaria* (Hale) Brusse, with a similar chemistry and lower surface colour. However, *P. protoquintaria* is most closely related to *Parmelia xanthomelaena* Müll. Arg., but contains the hypostictic acid cohort instead of the stictic acid series of the latter. The lobes are sublinear and removable with the lower surface intact throughout the thallus, whereas with *P. mesmerizans* this is not possible, because the centre is subareolate, although bullately so. The marginal lobes of *P. mesmerizans* are elongate, and do not possess a pored epicortex. Conversely, the marginal lobes of *P. protoquintaria* are sublinear, much less distinctly differentiated from the central lobes, and possess a pored epicortex.

Parmelia tantillum Brusse (1989; syn.: *Xanthoparmelia inconspicua* Hale) is another small species containing the hypostictic acid series, but this species is pale brown below, and also has a glossy upper surface with a pored epicortex.

Up until now, this new species is known only from the type locality, Matroos Mountain, the highest peak in the Hex River Mountains, near De Doorns.

Parmelia supposita Brusse, *sp. nov.* Fig. 6.

Thallus effigurato-crustosus, saxicolus, usque ad 3 cm diam. *Hypothallus* ater. *Lobi* sublineares, usque ad 3 mm longi, 0.1 - 0.5 mm lati, 70 - 180 μm crassi. *Thallus superne* flavo-viridis, subnitidus, isidiis sorediisque destitutus, epicortice destituto. *Cortex superior* 15 - 20 μm crassus. *Stratum*

gonidiale 20 - 50 μm crassum, algis *Trebouxiis*. *Medulla* albida, 10 - 110 μm crassa. *Cortex inferior* 7 - 9 μm crassus. *Thallus inferne* piceus, cum hypothallo atro bene evolutus. *Rhizinae* non evolutae. *Apothecia* immersa vel sessilia, usque ad 0.4 mm diam., discis badiis vel pallide badiis, saepe concavis. *Hypothecium* hyalinum, 15 - 30 μm crassum, J-. *Subhymenium* hyalinum, circa 10 μm crassum, J+ caeruleum. *Epihymenium* pallide badium, N-. *Hymenium* hyalinum, 35 - 45 μm altum, J+ caeruleum. *Asci* clavati, cum tholis J+ caeruleis (fig. 2). *Ascosporae* senae vel octonae, hyalinae, simplices, ellipsoideae, 9.5 - 12 X 5.0 - 6.5 μm. *Pycnidia* hyalina, globosa, 80 - 100 μm diam. *Spermatia* acicularia, hyalina, recta, 7 - 9.5 X 0.8 μm. *Thallus* acidum usnicum, acidum hyposticticum, acidum sticticum, acidum hypoconsticticum et acidum consticticum continens.

TYPUS: SOUTH AFRICA, CAPE PROVINCE - **3319** (Worcester): **-AC** (Tulbagh) Obiqua Mountains. Nuwekloof near Tulbagh. Farm: Nieuw Kloof. On W facing Table Mountain Sandstone kranz, on SW slope, in poort. Alt. 140 m. *F. Brusse 5496*, 22. iii. 1988 (**PRE**, holo-; **BM**, **LD**, iso-). Figura 6.

Thallus effigurate-crustose, saxicolous, up to 3 cm across. *Hypothallus* black. *Lobes* sublinear, up to 3 mm long, 0.1 - 0.5 mm wide, 70 - 180 μm thick. *Upper surface* yellow-green, subglossy, not isidiate and not sorediate; epicortex absent. *Upper cortex* 15 - 20 μm thick. *Algal layer* 20 - 50 μm thick, algae *Trebouxia*. *Medulla* whitish, 10 - 110 μm thick. *Lower cortex* 7 - 9 μm thick. *Lower surface* black, with well developed black hypothallus (sometimes thicker than lobes). *Rhizines* not developed. *Apothecia* immersed to sessile, up to 0.4 mm across, disc chestnut brown or lighter, often concave. *Hypothecium* hyaline, 15 - 30 μm thick, J-. *Subhymenium* hyaline, *ca.* 10 μm thick, J+ blue. *Epihymenium* toffee brown, N-. *Hymenium* hyaline, 35 - 45 μm high, J+ blue. *Asci* clavate, six- to eight-spored; tholus J+ blue (fig. 2). *Ascospores* hyaline, monolocular, ellipsoid, 9.5 - 12 X 5.0 - 6.5 μm. *Pycnidia* hyaline, globose, 80 - 100 μm diam. *Spermatia* hyaline, straight, needles, 7 - 9.5 X 0.8 μm. *Chemistry*: usnic, hypostictic, stictic, hypoconstictic and constictic acids present.

This is a very peculiar tiny new species in the artificial section *Xanthoparmelia*, in that the lobes are embedded in a black hypothallus, which is visible as black margins to the lobes under a dissecting microscope. The hypothallus can become very thick below, thicker than the thallus sometimes, and often includes some substrate grains. The hypothallus hyphae arise from the black lower cortex, which seems to be present throughout the thallus. This causes the lobes to be more easily removed than expected for an effigurate-crustose lichen. This development of a hypothallus is unknown in *Parmelia*, and consequently *Parmelia supposita* is a very distinct species. This new species was at first assumed to be *Parmelia adhaerens* Nyl., with the identical chemistry, but *P. adhaerens* is N+ fleeting blue in the epihymenium, whereas *P. supposita* is not. Although Brusse (1993) thought that all the type material of *P. adhaerens* is sterile, on checking the records it was found that one piece (**BM**) is fertile. This specimen has been re-examined and found to be N+ fleeting blue in the epihymenium. This fertile specimen at **BM** should be viewed as the holotype of *P. adhaerens* Nyl., because the material at **H**-Nyl is sterile and only a tiny fragment, and could at best be deemed a kleptotype.

A hypothallus is also lacking in *P. adhaerens*, which is attached to the rock substrate by means of small poorly developed rhizines and, in the interior, directly to the lower cortex.

The black margined lobes of this novel species, bring to mind other strikingly black margined species such as *Parmelia endochromatica* (Hale) Brusse, and *Parmelia ponderosa* Brusse, but these are larger species with gyrophoric acid and "schenckiana" pigments in the medulla. These latter species also do not possess a hypothallus.

This new species has been collected from two localities, Nuwekloof, just west of the historic town of Tulbagh, and Pakhuis Pass, north-east of Clanwilliam.

Additional Specimen Examined:

SOUTH AFRICA, CAPE PROVINCE - **3218** (Clanwilliam): **-BB** (Clanwilliam) 10 km NE of Clanwilliam, Pakhuis Pass, 50 m W of- and opposite entrance to Klein Kliphuis farm. On large Table Mountain Sandstone boulder-outcrop, on SW slope, on S faces, near ground. Alt. 600 m. *F. Brusse 4939*, 11. ii. 1986 (**B**, **BM**, **COLO**, **PRE**).

NOTES

The following "species" have been found to be based on material infected with lichen parasites, and are fraught with warts or galls caused by the parasites. These warts have previously been misinterpreted as dactyls by myself (Brusse 1989b, 1991), or sometimes "isidia" by Hale (1986, 1987) and even pustules that become "coarse subsorediate masses" or "coarse soredia" by Hale (1986, 1989, 1989a). They are *Xanthoparmelia areolata* Hale, *X. coneruptens* Hale, *X. eruptens* Hale, *X. evernica* Hale, *X. pustulifera* Hale, *X. saniensis* Hale. Some so-called species possess rather elongate linear warts, resembling incipient linear soralia, and warts or galls of this type have been found on *Xanthoparmelia pustulosorediata* Hale and *X. rubropustulata* Hale, and have been noticed on several other species such as the brown *P. parilis* Brusse and the grey *P. molybdiza* Nyl. When mature these warts become rather hollow inside and break open, and then resemble pustules. The type material of *Psiloparmelia arhizinosa* Hale may also be similarly infected with a parasite, causing abnormalities that have been interpreted as pustules erupting into coarse sorediate masses (Hale 1989a, Elix & Nash 1992). It seems that lichens growing in overhang positions are more susceptible to succumb to infection by lichen parasites.

Regrettably I have made combinations in *Parmelia* in error for some of these lichens, but the status as good species, without the lichen parasite induced changes, is still unclear for some of them, especially since the parasites can also effect changes in chemistry. Documented examples of how lichen parasites can cause changes in chemistry are given by Hawksworth, Paterson & Vote (1993), where the chemistries of various lichens are diversified by infection. In *Parmelia* the genera *Polycoccum* and *Nesolechia* are overwhelmingly common as parasites. *Nesolechia* is a parasite that has acquired this habit from the lichenized condition in the past (i.e. it is a degenerate lichen), but there are no reports of chemical changes caused by this parasite as yet. *Polycoccum* is a fungus with no history of lichenization, that has adapted to parasitizing lichens presumably from saprophytic or plant/fungal parasitic ancestors, and the possibility that this parasite could elaborate on the host chemistry is remote. However, this type of parasite could still induce the host to change its chemistry under conditions of infection. Nevertheless, the chemistry is often not altered, and these cases can clearly be withdrawn for the time being, as is done in some of the entries below.

Parmelia evernica (Hale) Brusse

The original material I saw had a few dark tipped isidium-like structures on it, and this was the basis of the new combination (Brusse 1989a).

However, I have recently received further material of this lichen, and it clearly is *Parmelia lecanoracea* Müll. Arg. with warts caused by a lichen parasite.

PARMELIA PROTOQUINTARIA (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia protoquintaria* Hale, Mycotaxon **34**: 556. 1989.

This species is the hypostictic acid series containing counterpart of *Parmelia xanthomelaena* Müll. Arg., which produces the stictic acid cohort.

Parmelia rubropustulata (Hale) Brusse

This is another clear-cut case of a lichen parasite, in this case infecting *P. endomiltodes* Nyl. The brown *P. parilis* Brusse has also been seen infected, producing the same linear wart structures, which burst or break open, and then look like pustules.

Parmelia saniensis (Hale) Brusse

When making the new combination *Parmelia brevilobata* (Hale) Brusse (1991), the structures on this lichen were thought to be dactyls, but these are plainly the work of a lichen parasite, and thus *P. brevilobata* is synonymous with *P. saniensis*. The minor substance in this lichen, which I originally thought may be lividic acid, is in fact unknown TE-2 (Esslinger 1977), which occurs in the brown *P. fissurina* Zahlbr., a common lichen at higher altitudes in the Cape Province. Although quite similar to *P. subcrustacea* Gyeln., *P. saniensis* contains unknown TE-2 and the pigment skyrin in the medulla near the lower cortex, in addition to the hypostictic, hyposalazinic, hypoconstictic acids and unknown PQ-3 (the hypostictic acid cohort), which they both contain (Elix 1981; Elix, Johnston & Armstrong 1986; Hale 1990). *P. saniensis* has a years priority over *P. brevilobata*, and is therefore the correct name for this lichen, despite the presence of the parasite.

ACKNOWLEDGEMENTS

I wish to convey my sincere thanks to Prof. D. L. Hawksworth (London) for very kindly reviewing this paper. The examination of type and other valuable material from **B**, **BM**, **COLO**, **FH**, **G**, **GLAM**, **H**, **LD**, **TNS**, **TRH**, **TUR**, **US**, **VER**, **W**, & **ZT**, is gratefully acknowledged. The photography is the generous work of Mrs A. J. Romanowski, to whom I extend my thanks. The author is grateful for the friendly co-operation from several magnanimous private landowners who allowed the author to look for lichens on their properties. The author is especially grateful to the South African Ski Club (Cape Town) for the kind permission to use their elegant Peak Hut on the summit of Matroos Mountain, and for permitting access to their leased ski area on this mountain.

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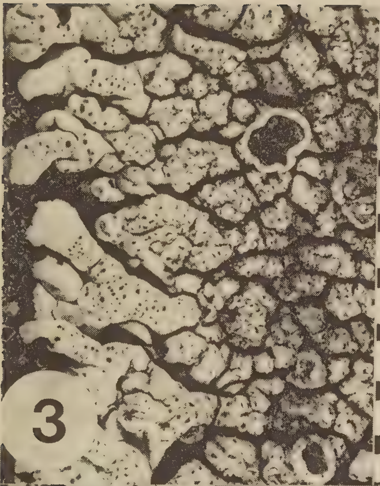
FIGURE 3. - *Parmelia chionophila* Brusse, habit. *F. Brusse 6166*, holotype. Scale in mm.

FIGURE 4. - *Parmelia emolumenta* Brusse, habit. *F. Brusse 6165*, holotype. Scale in mm.

FIGURE 5. - *Parmelia mesmerizans* Brusse, habit. *F. Brusse 6141*, holotype. Scale in mm.

FIGURE 6. - *Parmelia supposita* Brusse, habit. *F. Brusse 5496*, holotype. Scale in mm.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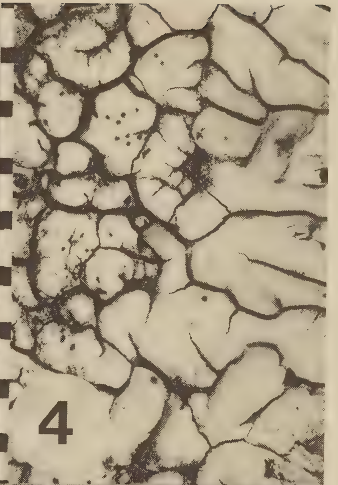
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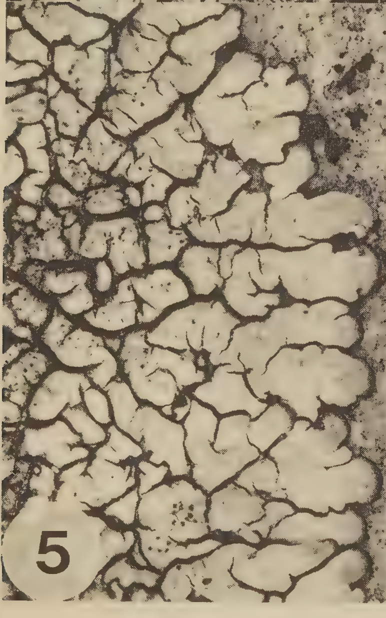
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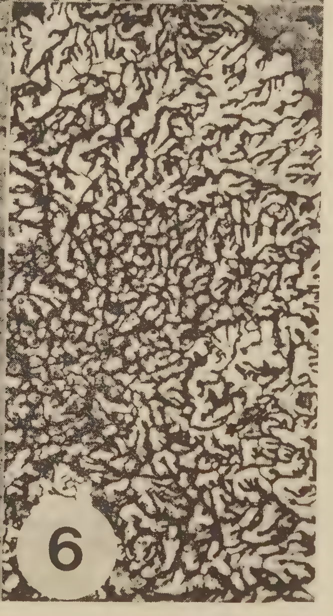
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MYCOTAXON

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FURIA SHANDONGENSIS (ZYGOMYCETES: ENTOMOPHTHORALES), A NEW PATHOGEN OF EARWIGS [1]

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Abstract: An epizootic of *Forficula* sp. was recorded in Eastern China. The causal agent is an entomophthoralean species that differs from *Erynia forficulae* and *Furia ellisiana*, and is described here as *Furia shandongensis*, sp. nov., the third pathogen of earwigs. Its primary conidia are obovoid, 16.8–22.8 × 9.6–12.0 µm (averaging 19.9 × 10.3 µm, L/D = 1.6–2.3). Cystidia and rhizoids are as wide as conidiophores, and rhizoids have no terminal holdfasts. Resting spores are 26.4–36.0 µm in diameter.

Keywords: Forficulidae, Dermaptera, Entomophthorales, *Furia shandongensis*

INTRODUCTION

An epizootic of earwig adults and nymphs (Forficulidae) was observed in suburban Jinan, Shandong Province, Eastern China, in August 1990. Cadaver density was 1-2 per m^2 in their damp, dark habitats under pots and shading matting, and in cracks of walls and soil. The cadavers were

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attached to substrates with their legs. The anterior and posterior ends of the cadavers bent upwards (Fig. 1). White hymenia emerged from the intersegmental membranes of the thorax and abdomen, kept extending, and finally joined together making the whole cadaver look creamy. The great number of conidia discharged around the cadavers indicated an entomophthoralean infection. These conidia were homogeneous, suggesting that only one fungal species was the pathogen of the epizootic.

MATERIALS AND METHODS

Morphological methods of Li and Humber (1984) were used to make glass slide preparation for microscopic observation on primary and secondary conidia, hyphal bodies, conidiophores, cystidia, rhizoids, and resting spores. Except for aceto-orcein used for nuclear staining, lactophenol-aniline blue was used for other staining and dissecting work.

For isolation and maintenance, potato dextrose agar (PDA), Sabouraud dextrose agar (SDA), and coagulated egg yolk + Sabouraud maltose agar (EYSMA) (Soper et al., 1975) were used. Growth rates on the three media were compared at 24°C.

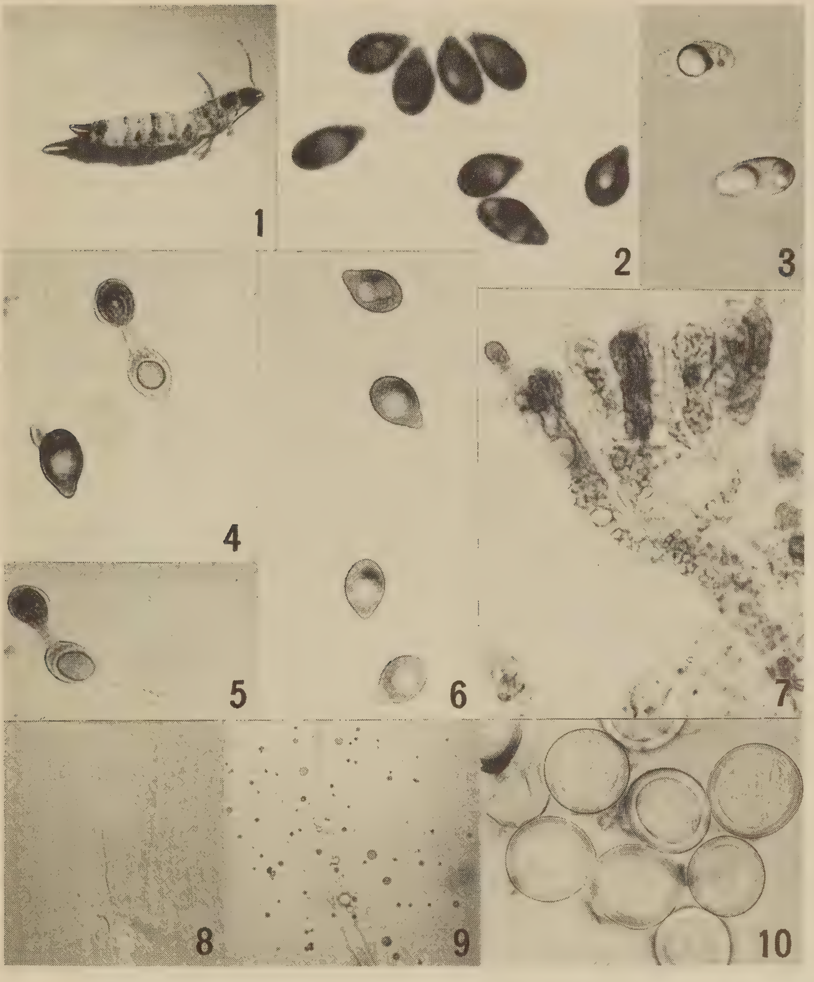
RESULTS AND DISCUSSION

The microscopic characteristics of the specimens collected agreed with the description of the genus *Furia* (Batko) Humber (1989) but were not attributable to any described species of this genus. The description of this new species is based on the microscopic observation of the specimens .

FURIA SHANDONGENSIS Wang, Lu & Li, sp. nov. **[Figs. 1-10]**

CONIDIA PRIMARIA uninucleata, bitunicata, incolorata, obovoidea, plerumque symmetrica, 16.8–22. 8 × 9.6–12.0 μm (med. 19.2 ± 1.2 × 10.3–0.9 μm), L/D= 1.6–2.3). CONIDIA SECUNDARIA obovoidea sed minora, 13.2–16.8 × 9.6–12.0 μm (med. 14.9 ± 0.9 × 10.1 ± 0.8 μm, L/D = 1.2–1.7). Capilliconidia desunt. CORPORA HYPHALIA clavata vel hyphoidea, 7.2–9.6 μm in diam. CONIDIOPHORA bifurcata, 9.6–12.0 μm in diam. CYSTIDIA aseptata, simplicia, basi 9.6–10.8 μm in diam., gradatim angustata. RHIZOIDEA monohyphoidea, Y–ramosa ad apicem, 9.6–12.2 μm basi in diam. SPORAE PERDURANTES sphaericae, hyalinae, 26.4–36.0 μm in diam. (med. 31.1 ± 2.4 μm).

PRIMARY CONIDIA (Figs. 2–3) uninucleate, bitunicate, colorless, obovoid, with a rounded apex and a rounded papilla, mostly symmetric,



FIGURES 1-10. ***Furia shandongensis.*** 1. A dead earwig with fungal hymenia protruding from intersegmental membranes. 2-3. Primary conidia, ×590. 4-6. Secondary conidia, ×590. 7. Conidiophores, ×590. 8. A cystidium, ×250. 9. A rhizoid, ×250. 10. Resting spores, ×400.

16.8–22.8 × 9.6–12.0 μm (averaging 19.9 ± 1.2 × 10.3 ± 0.9 μm, L/D = 1.6–2.3, n = 100), with cytoplasm containing 1-2 large vacuoles, forcibly discharged by papillar eversion. SECONDARY CONIDIA (Figs. 4–6) similar to primary conidia but smaller, 13.2–16.8 × 9.6–12.0 μm (averaging 14.9 ± 0.9 × 10.1 ± 0.8 μm, L/D = 1.2–1.7, n = 100). No capilliconidia formed. HYPHAL BODIES clavate or hypha-like, 7.2–9.6 μm wide, multinucleate. NUCLEI elliptical to subglobose, 5.1-8.0 × 2.5-5.1 μm in primary conidia. CONIDIOPHORES bifurcately branched (Fig. 7), determinate, 9.6–12.0 μm in diam., usually covering intersegmental membrane of host bodies or forming continuous pale yellowish hymenia. CYSTIDIA (Fig. 8) emerging through cuticle of dead host before conidiophores, aseptate, unbranched, 9.6–10.8 μm wide at base, tapering gradually to a rounded tip 5.0–6.5 μm wide. RHIZOIDS (Fig. 9) hypha-like, Y-branched, 9.6–12.2 μm wide at base. RESTING SPORES (Fig. 10) spherical, hyaline, smooth, 26.4–36.0 μm in diam. (averaging 31.1 ± 2.4 μm), with bilayered wall 2.6–3.7 μm thick.

Holotype: ACAFP 11025; adult of *Forficula* sp.; deposited at herbarium of Forest Protection, Department of Forestry, Anhui Agricultural University. Collected by Weimin Wang.

Paratypes: AEU08820–1 through 5; adults and nymphs of the same host species; deposited at Mycological Laboratory, Institute of Atomic Energy Use, Shandong Academy of Agricultural Sciences. Collected by Weimin Wang.

Type Host: *Forficula* sp. (Dermaptera: Forficulidae)

Type Locality: East suburbs of Jinan, Shandong; 20 August 1990.

The following characteristics make this fungus attributable to *Furia* (Batko) Humber (1989): uninucleate and bitunicate conidia, bifurcately branched conidiophores, hypha-like cystidia as wide as conidiophores, and monohyphal rhizoids which are as wide as conidiophores and have no strongly differentiated holdfast.

There are two earwig-pathogenic species published. The first was described as *Entomophthora forficulae* Giard (1889). Its conidia were long ellipsoid, 20-25 × 6.8 μm. The available information was too limited for Ben-Ze'ev and Kenneth (1982) to assign the species to any subgenus of the genus *Erynia* in their neo-Batkoan classification or for Humber (1989) to place it among the four genera in his revised classification derived from *Erynia* Nowakowski emend. Humber & Ben-Ze'ev (1981). The second species, *Furia ellisiana* (Ben-Ze'ev) Humber, was originally described as *Empusa forficulae* var. *major* Petch (1944) and redescribed as *Erynia ellisiana*

Ben-Ze'ev (1986) before its transfer to *Furia* by Humber (1989). Its primary conidia were obovoid, multivacuolate, 19.8–30.0 × 12.6–20.2 µm. Rostrup (1893, cited in Petch, 1944) recorded a fungus as *Entomophthora forficulae* on earwigs in Denmark which was different, as is *Furia shandongensis*, from the above two species by the primary conidia 18-21 × 8-10 µm, with a vacuole at each end. As Ben-Ze'ev noted, it appeared to be the third species attacking Dermaptera. The new species described here as *F. shandongensis* has similar magnitude to that measured by Rostrup and cited by Petch (1944), and they probably are the same fungus although the 1 or 2 vacuoles of *F. shandongensis* are mostly central rather than the polar ones observed by Rostrup.

In the genus *Furia*, *F. crustosa* (MacLeod & Tyrrell, 1979) Humber and *F. ithacensis* (Kramer, 1981) Humber have measurements close to that of *F. shandongensis* but their resting spores have undulate or deeply incised epispores in comparison with the smooth resting spores of *F. shandongensis*. The first species is a pathogen of Lepidoptera and the second is pathogenic to dipterans whereas *F. shandongensis* is a pathogen of the Dermaptera.

This fungus could grow on PDA and EYSMA, but not on SDA. Its growth rate on EYSMA was three times faster than on PDA. The primary conidia produced on EYSMA were similar in shape and size (19.6 × 10.6 µm) to those produced on the host. Resting spores formed on both media were ca. 27.1 µm in diameter and had walls ca. 2.9 µm thick.

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TWO NEW PATHOGENS OF DIPTERAN INSECTS [1]

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Abstract: Two new entomophthoralean fungi pathogenic on dipteran insects were recorded in China. *Pandora shaanxiensis* was found on blue bottle flies in Shaanxi, Northwestern China. Its primary conidia are obovoid, symmetric, 30.3–43.2 × 12.5–19.8 µm (averaging 32.7 × 15.0 µm), L/D = 1.7–3.2 (averaging 2.4). Cystidia are 2 times the thickness of conidiophores, and rhizoids end in a discoid holdfast. *Erynia chironomis* was found in an epizootic of chironomid midges in Anhui, Eastern China. Its primary conidia are narrow, obovoid, usually asymmetric and sometimes curved, the largest diameter in the apical half, 29.260.6 × 10.4–21.9 µm (averaging 41.1–48.0 × 13.5–17.1 mm), L/D = 2.1–4.3 (averaging 2.5–3.6). Cystidia are 203 time the thickness of conidiophores. Rhizoids are 2 times the thickness of conidiophores and do not terminate in terminal discoidal holdfasts.

Keywords: Entomophthorales; *Pandora shaanxiensis*; *Erynia chironomis*, Diptera, Calliphoridae, Chironomidae

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[1] Supported by National Natural Science Foundation of China.

[2] Author to whom all correspondence should be addressed.

Insects of the Diptera are among the main hosts of entomophthoralean fungi. In a seven year survey for the resources of this fungal group in China, two new pathogen fungi were found. The first one was a pathogen of green bottle flies in northwestern China and could be attributed to the genus *Pandora*. The second one caused an epizootic in a chironomid midge population and was a member of the genus *Erynia*. They did not agree with the descriptions of any published species of the respective genera and are described here as two new species.

MATERIALS AND METHODS

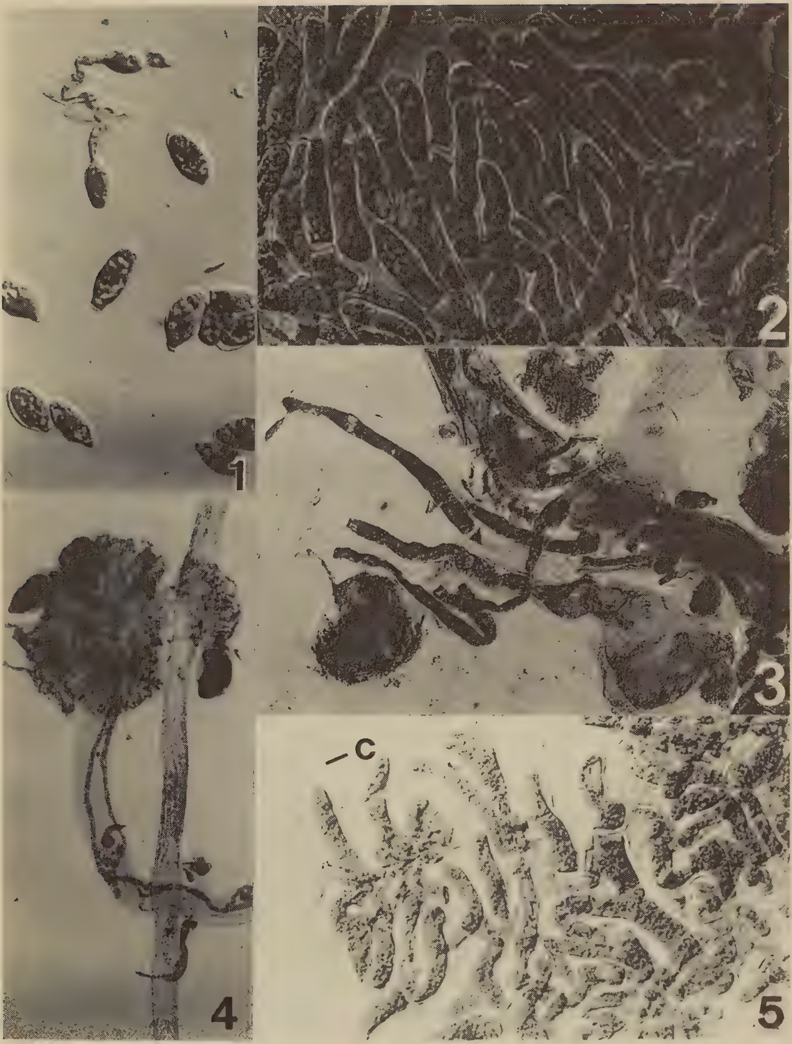
The methods of Li and Humber (1984) were used for morphological observation in glass slide material preparation. Lactophenol-cotton blue (LPCB) and lactophenol-aceto-orcein (LPAO) (Keller and Wilding, 1985) were used for staining.

RESULTS AND DISCUSSION

Some cadavers of green bottle flies, *Lucilia* sp., were found on leaves of persimmon trees in Lintong, Southeastern Shaanxi Province, in northwestern China on 22 September 1991. The cadavers were attached to the leaves by numerous rhizoids. The creamy hymenia emerged from intersegmental membranes. The microscopic appearance of the specimens showed obvious characteristics of the genus *Pandora* Humber (1989): conidia were uninucleate and bitunicate, cystidia were 2 times the thickness of conidiophores, and the rhizoids had discoid holdfasts and were 2-3 times the thickness of conidiophores. The species was not attributable to any described species of this genus and is described here as new species:

PANDORA SHAANXIENSIS Fan & Li, sp. nov. **[Figs. 1–5]**

CONIDIA PRIMARIA uninucleata, bitunicata, incolorata, obovoidea, papillis truncatalae, plerumque symmetrica, 30.3–43.2 × 12.5–19.8 µm (med. 32.7±3.0 × 15.0±1.2 µm; L/D = 1.7–3.4). CONIDIA SECUNDARIA obovoidea sed minora, 13.2–16. 8 × 9.6–12.0 µm (med. 14.9±0.9 × 10.1±0.8 µm, L/D = 1.2–1.7). Capilliconidia desunt. CORPORA HYPHALIA magna, ovoidea vel sphaerica, 79-5–112.2 × 37.4–74.8 µm, vel clavata, 65.4–107.5 × 14.0–23.4 µm. CONIDIOPHORA bifurcata, 6.9–9.2 µm in diam. CYSTIDIA aseptata, robusta, 13.8–16.1 µm in diam. RHIZOIDEA hyphoidea, desinentia in haptera discoidea, 16.7–31.7 µm in diam. SPORAE PERDURANTES desunt.



FIGURES 1–5. ***Pandora shaanxiensis.*** 1. Primary and secondary conidia, ×260. 2. Conidiophores, ×440. 3. Hyphal bodies and conidiophores arising from the hyphal bodies, ×250. 4. Rhizoids with disc-like holdfast, ×210. 5. Conidiophores and a cystidium, ×440.

PRIMARY CONIDIA (Fig. 1) uninucleate, bitunicate, colorless, obovoid, with nearly rounded apex and a slightly truncate papilla, mostly symmetric, 30.3–43.2 × 12.5–19.8 µm (averaging 32.7±3.0 × 15.0±1.2 µm, L/D = 1.7–3.4, averaging 2.4±0.3; n = 100), with cytoplasm containing several vacuoles, forcibly discharged by papillar eversion. SECONDARY CONIDIA (Fig. 1) similar to primary conidia but smaller; no capilliconidia formed. HYPHAL BODIES large, ovoid to subspherical, 79.5–112.2 × 37.4–74.8 µm, or clavate, 65.4–107.5 × 14.0–23.4 µm. Conidiophores arise from these hyphal bodies; cytoplasmic transfer to the conidiophores leaves empty saccular cells (Fig. 3). NUCLEI elliptical to subglobose, centrally located, 7.0–12.2 × 4.5-8.4 µm in primary conidia. CONIDIOPHORES bifurcately branched (Figs. 2,5), determinate, 6.9–9.2 µm wide, covering intersegmental membranes. CYSTIDIA (Fig. 5) aseptate, rarely branched, robust, 13.8–16.1 µm wide. RHIZOIDS (Fig. 4) hypha-like, terminating in discoid holdfast, usually in bundle of several rhizoidal threads, 16.7–31.7 µm thick. RESTING SPORES not observed.

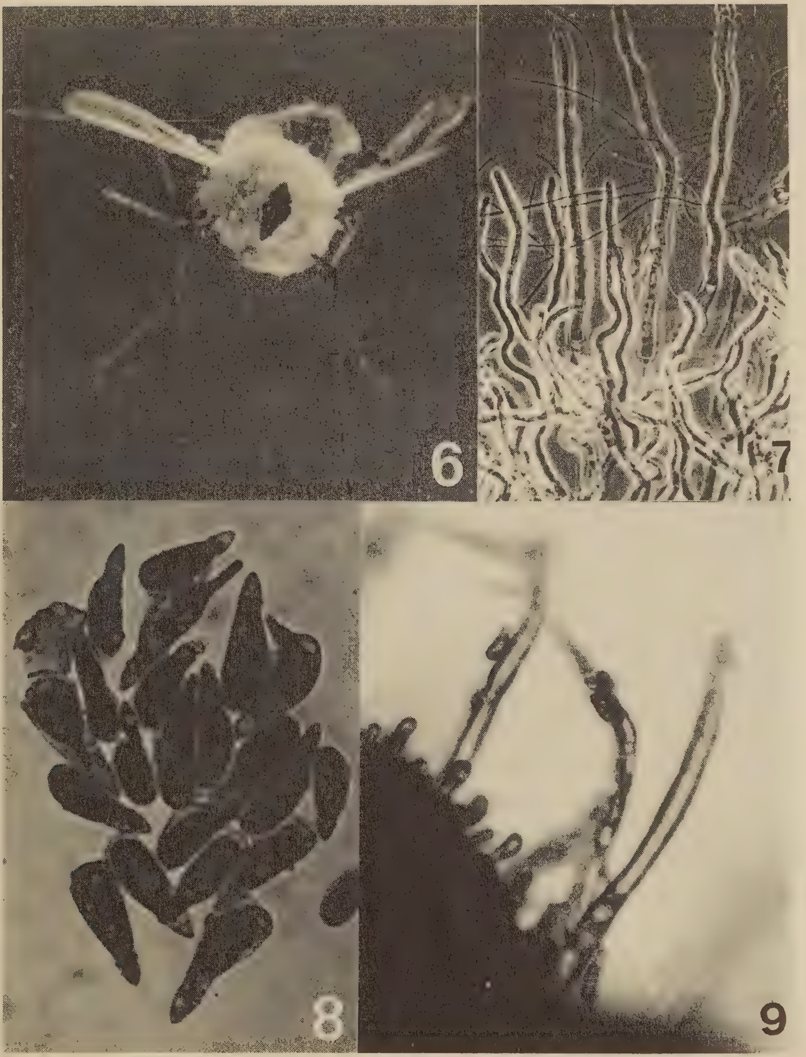
Holotype: ACAFP 11027; adult of green bottle fly; deposited at herbarium of Forest Protection, Department of Forestry, Anhui Agricultural University. Collected by Dahong Yang.
Type Host: *Lucilia* sp. (Diptera: Calliphoridae)
Type Locality: Lintong, Shaanxi; 22 September 1991.

There are no species in the genus *Pandora* which have conidial measurements close to those of *P. shaanxiensis*. Very few specimens were collected in and around the type locality, thus suggesting that the host flies were infected during an enzootic.

The second species caused an epizootic in a chironomid midge population. Greyish green hymenia appeared first from intersegmental membranes of the midge adbomens, and eventually covered almost the whole bodies of the hosts.

PANDORA CHIRONOMIS Fan & Li, sp. nov. **[Figs. 6–9]**

CONIDIA PRIMARIA uninucleata, bitunicata, incolorata, anguste obovoidea, plerumque asymmetrica interdum parum curva, 29.2–60.6 × 10.4–21.9 µm (med. 41.1± 5.7 – 48.0±10.1 × 13.5±1.9 – 17.1±3.8 µm; L/D = 2.1–4.3, med. 2.5±0.3–3.6± 0.5), papillis angustis, longis vel parum rotundatis, collariatis. CONIDIA SECUNDARIA similia conidiorum primariorum sed angustora, 28.2–37.9 × 8.0–10.4 µm (med. 33.4±



FIGURES 6–9. ***Erynia chironomis.*** 6. A midge cadaver with thick hymenium on the abdomen, ×7. 7. Rhizoids and conidiophores, ×80. 8. Primary conidia, ×360. 9. Cystidia and conidiophores, ×130.

3.4 × 9.9±0.9 μm, L/D = 2.7-3.9), vel sphaerica pyriformia, 17.4–20.5 × 1.2–15.3 μm (med. 18.7±1.0 × 13.8±0.8 μm; L/D = 1.2–1.4); capilliconidia et conidia coronata desunt. CORPORA HYPHALIA clavata, 6.3–10.4 μm in diam. CONIDIOPHORA ramosa vel simplicia, 8.4–13.6 μm in diam. CYSTIDIA abunda, longa, robusta, aseptata, 21.7–38.4 μm in diam., basaliter, usque ad 668 μm longa. RHIZOIDEA abunda, monohyphoidea, 14.5–24.3 μm in diam. SPORAE PERDURANTES desunt.

PRIMARY CONIDIA (Fig. 8) uninucleate, bitunicate, colorless, narrowly obovoid, usually asymmetric and sometimes curved, with largest diameter in the apical half, apex broadly rounded or somewhat truncate, tapering to a narrow, long, triangular or slightly rounded and collared papilla; 29.2–60.6 × 10.4–21.9 μm (averaging 41.4±5.7 – 48.0±10.1 × 13.5±1.9 – 17.1±3.8 μm; L/D = 2.1–4.3, averaging 2.5±0.3 – 3.6±0.5; n = 100), with cytoplasm containing one to several large vacuoles; forcibly discharged by papillar eversion. SECONDARY CONIDIA (Figs. 9, 10) similar to primary conidia but narrower, 28.2–37.9 × 8.0–10.4 (averaging 33.4±3.4 × 9.9±0.9 μm; L/D = 2.7–3.9, averaging 3.4±0.4), or spherical to pyriform, 17.4–20.5 × 12.2–15.3 μm (averaging 18.7±1.0 × 13.8±0.8 μm; L/D = 1.2–1.4, averaging 1.4±0.1); no capilliconidia or tetraradiate conidia formed. HYPHAL BODIES clavate, 6.3–10.4 μm wide. NUCLEI elliptical, 6.3–20.9 × 3.5–7.0 μm in primary conidia. CONIDIOPHORES branched or simple, 8.4–13.6 μm wide, usually forming continuous and thick greyish-green hymenia eventually covering the whole bodies of the hosts. CYSTIDIA (Fig. 9) abundant, long, robust, aseptate, unbranched, 14.6–22.8 μm wide in the middle and 21.7–38.4 μm wide at the level of the conidiophores, up to 688 μm long. RHIZOIDS (Fig. 7) abundant, robust, long, monohyphal, 14.5–24.3 μm wide without differentiated holdfast. RESTING SPORES not observed.

Holotype: ACAFP 10523; adult of midge; deposited at herbarium of Forest Protection, Department of Forestry, Anhui Agricultural University. Collected by Zengzhi Li.
Type Host: *Chironomus* sp. (Diptera: Chironomidae)
Type Locality: Hefei, Anhui; 23 May 1991.

This pathogen caused very high mortality (>80%) of the midges in a little pool during a rainy season which lasted for almost a continuous month. The macroscopic and microscopic appearance resemble those of *Erynia conica* (Nowakowski) Remaudière & Hennebert and *E. rhizospora* (Thaxter) Remaudière & Hennebert. *E. chironomis*, however, has the largest diameter of conidia in the apical half and is usually much narrower although its length is within that of *E. conica* (Thaxter, 1888; Gustafsson, 1965; Keller, 1991). The new species can be distinguished from *E. rhizospora* (Thaxter, 1888; Keller, 1991) by its much longer and narrower conidia and by its shorter papillae. The conidia of *E. chironomis* are also similar to those of *E. aquatica* (Anderson & Anagnostakis) Humber, but those of the latter are much shorter and narrower and usually have only a single large vacuole (Anderson and Ringo, 1969).

The generic name *Erynia* has been confusing. Nowakowski (1881) published it invalidly and, in fact, rejected it (Nowakowski, 1883). Batko (1966) validated this name at the subgeneric level 83 years later, but Remaudière and Hennebert (1980) used the validated *Erynia* at the same (generic) rank with *Zoophthora*. Humber and Ben-Ze'ev (1981), however, emended *Erynia* Nowakowski to cover all species of *Zoophthora* Batko. Ben-Ze'ev and Kenneth (1982) used this generic name in the same, expanded sense. Humber (1989) proposed a new classification in which the emended *Erynia* was divided into 4 genera – *Erynia*, *Furia*, *Pandora*, and *Zoophthora*. Keller (1991) accepted the revision of Remaudière and Hennebert (1980) and rejected both the emendation by Humber and Ben-Ze'ev (1981) and the separation by Humber of the four genera. Based on the taxonomic work leading to the descriptions of *Furia shandongensis* (Wang et al., 1994) and of *Erynia chironomis* and *Pandora shaanxiensis* here, the revision by Humber (1989) is found to be reasonable, practical, and acceptable.

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A NEW CORTINARIUS FROM A MATURE ASPEN STAND IN MONTANA

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ABSTRACT

Cortinarius hedyaromaticus, a large, white Phlegmacium with a strong, sweet odor, is described as a new species from a mature stand of Populus tremuloides in southwestern Montana.

Key Words: aspen, Cortinarius, Phlegmacium, Populus tremuloides, Montana.

INTRODUCTION

Large clonal stands of aspen (Populus tremuloides Michx.) are a prominent feature of the landscape in western North America, especially in montane regions associated with the Rocky Mountains. Although aspen is usually considered a pioneering species in this area, eventually being replaced by conifers, it may persist to form mature stands. An unknown large, whitish, sweet-smelling Cortinarius with a greasy cap was discovered in one such stand during a survey to document the ectomycorrhizal fungi associated with aspen in southwestern Montana (Cripps 1992). The stand is on the floor of a glaciated valley at an elevation of 1900 m. in Park County, Montana, 5 miles north of Yellowstone National Park. Although the stand is nearly pure aspen, engelmann spruce (Picea engelmanii Parry ex. Engelm.), douglas-fir (Pseudotsuga menziesii Mirb.Franc), and lodgepole pine (Pinus contorta Dougl. ex Loud) have invaded in some areas, and willow and alder are found in the wetter areas. These are all potentially ectomycorrhizal trees, but aspen is the most likely host. Ten of the largest trees on the site were cored and ages ranged from 56 to 114 years, averaging 81 years. This is a productive site with a deep, gravelly loam soil of glacial till, and has remained undisturbed by fire for many years.

Sporocarps of the Cortinarius were found in the same local area in late summer in 1991, and 1992 on this site, and representative specimens were mailed to Dr. Meinhard Moser who agreed this was a new taxon.

Methods: Collections were photographed on the site, smell and taste recorded, and the sporocarps wrapped in wax paper. Potential mycorrhizal hosts were noted. Morphological descriptions were made on fresh material. Specimens were dried for microscopic examination at a later date. All sections were prepared in 3% KOH unless otherwise noted. Collections are in the Massey Herbarium (VPI), Blacksburg, Virginia.

TAXONOMY

Cortinarius hedyaromaticus sp. nov. C. Cripps and O.K. Miller

Illustrations: Figs. 1-7.

Pileus: 7-15 cm latus, hemisphaericalis vel late convexus, rasilis, in juventute sebosus, aridus, saepe areolatus in aetate; margo persistenter involutus, interdum appendiculatus, bubalinus sed in aetate corylinus, si contusus porphyreus, rare violaceo-griseo tinctus. Lamellae subdecurrentes, confertae, parum latae, in juventute albidae, deinde brunnneae; margines brunneo-vinosi si contusi. Stipes variabilis, 7-11 cm longus, -2.5 cm latus, aequalis vel ad basem auctus deinde abrupte decrescens usque ad punctum vinosum si contusum, bubalinus aridus fibrillis sparsis; apex albus pulveraceus, in aetate interdum lilacinus super zonam annularem, caro lenta. Velum partiale cortinatum vel paene membranaceum, album, superiorem zonem annularem relinquens. Contextus firmus, albus, interdum ferrugineus si contusus. Odor dulcis, saepe fortis. Sapor mitis vel parum amarus. Sporae 9.5-11(-13) x 5.5-6.5(-7.5) μm diametro, verrucosae subamagdaliformes, extremo obtuso. Depositum sporarum brunneum. Pileipellis mixocutis est hypharum filamentosarum. Trama lamellaris parallela cellularum 7-15 μm latarum. Cystidia absentia. Typum legit: CLC 316, 28 August, 1991, Cinnabar Basin, Park Co., Montana.

Pileus: up to 15 cm broad, at first hemispherical with heavily inrolled margin becoming broadly hemispherical (Figs. 3 & 4), convex or domed with wavy or inrolled margin which is sometimes areolate or rimose, greasy at first, becoming smooth and dry, at center often coarsely areolate in age or on drying, cream buff (whitish) or pinkish-buff at first, bruising rusty brown especially at the margin (reminiscent of a Hebeloma), occasional appendiculate pieces of the white partial veil (Fig. 6), maturing to light brown and remaining so when dried, localized areas often with steel grey, blue grey, grey brown, or grey violet tints at different maturation stages. **Lamellae** subdecurrent, crowded, medium broad, pale cream-buff to clay color young becoming light cocoa then brown, edges bruising vinaceous-brown, violet-gray to steel-gray. **Stipe** extremely variable, 7-11 cm long, up to 2.5 cm broad, equal, enlarging somewhat toward the base and then abruptly tapered and pointed at the base (which may bruise vinaceous), dry, whitish cream at first with sparse rusty fibrils and a few very pale yellow patches at apex, apex often powdery, with steel-gray to gray-violet tints above superior annular zone in older specimens, on bruising, or on drying (Fig. 5), stipe flesh extremely firm. **Partial veil** cortinous to nearly membranous (Fig. 7), white, soon gone leaving superior rusty zone. **Context** firm, white, brown around worm holes, staining buff to vinaceous or red-brown at stipe apex, pale yellow in ammonia, negative in FeS04. Taste mild to slightly bitter. Smell strong, sweet like vanilla cake batter (rarely faint), then sickenly sweet on drying!

Pileipellis: a mixocutis, upper layer of gelatinized, hyaline, filamentous hyphae, 3.5-4.2 μm wide, below a golden layer of hyphae, 3.5-5.0(-7) μm wide, some with pigmented walls, some hyaline, some with incrustations, clamps present. **Pileus trama** of broadly filamentous, inflated hyphae, 7.6-13 (-20) μm wide, clamps scattered. **Lamellar trama** parallel, of thin-walled hyphae 7-15 um wide. **Subhymenium** a narrow layer of hyphae 5-8 μm in diameter. **Basidia**, 4-spored, clavate, 30-40 x 8-10 μm, clamps at base (Fig. 1). **Partial veil** of filamentous hyphae, 3-5 μm wide, clamps frequent.

Basidiospores: 9.5-11(-13) x 5.5-6.5(-7.5) μm, D^m = 10.4 x 6.0 μm, average Q = 1.7, verrucose, subamygdaliform to almost almond-shaped, with slightly flattened, blunt obtuse end (Fig 2). Spores brown in mass, not rusty-brown.

Habitat & distribution: terrestrial, often in clumps or in a ring, beneath mature aspen (*Populus tremuloides*) in southwestern Montana. Fruiting in late summer.

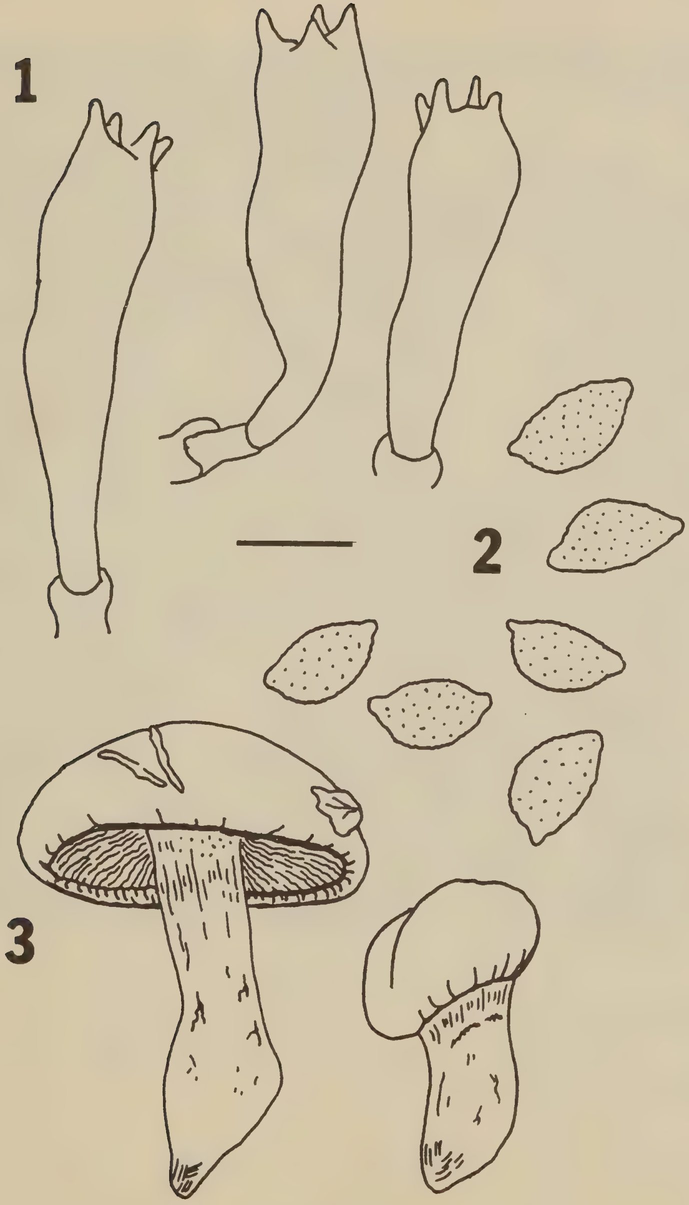
Material examined: United States. Montana, Park Co, Cinnabar basin: 28 August, 1991, CLC 316 (holotype); 11 August, 1991, CLC 260; 13 July, 1992.

Observations: The greasy cap and dry stipe place this *Cortinarius* firmly in the subgenus Phlegmacium. The stirps Rapaceum in Section Phlegmacium (Moser 1960) which is characterized by a white, whitish, to cream-ochraceous cap color, as well as clay-colored lamellae when young, best fits our taxon. Within this group, *C. lustratus* Fr. has a similar color and looks related, but is small, has smaller spores (6.5-8 x 3.5-4.5 μm), and a floury smell. *C. aleuriosmus* R. Mre has similar colors but a rather strong farinaceous odor, and a marginately bulbous base. The same is true for *C. osmophorus* P.D. Orton, which is described with bluish shades in the stipe, a taxon Moser (pers. written comm.) believes to be a synonym of *C. aleuriosmus*, where slight bluish shades can occur. C. amarescens (Mos.) Mos. is similar but has an abrupt bulb, strongly bitter flesh (not in ours), and is a less robust species with a cap 3-5.5 cm in diameter, stipe 6-7.5 cm long, 9-15 mm wide with bulb 15-20 mm wide. Our stipe is 7-11 cm long, up to 2.5 cm broad. Flora Agaricina Danica (Lange 1938) plate 82. fig. B (C. talus ss Lange), is in the related group with similar coloration, a viscid cap 4-7 cm, similar spores 8.5-10.2(-11) x 5-5.5 µm, but the bulb is marginate, abrupt and rounded unlike ours, and the taste is bitterish. Moser considers C. talus ss Lange above as a synonoym of Phlegmacium amarescens (Mos.) Mos. (Moser 1960, p. 146). Lange (1938)) says the taxon is "very close to C. multiformis but paler, more viscid and somewhat bitter." C. multiformis (Fr.) Fr. differs from our taxon in an ochre-pallid to yellow-brown cap color and the presence of a bulbous base, but has similar spores and a similar sweet honeylike odor (illustrations: Dähnke and Dähnke 1979, Bresadola 1982, Ricken 1915).

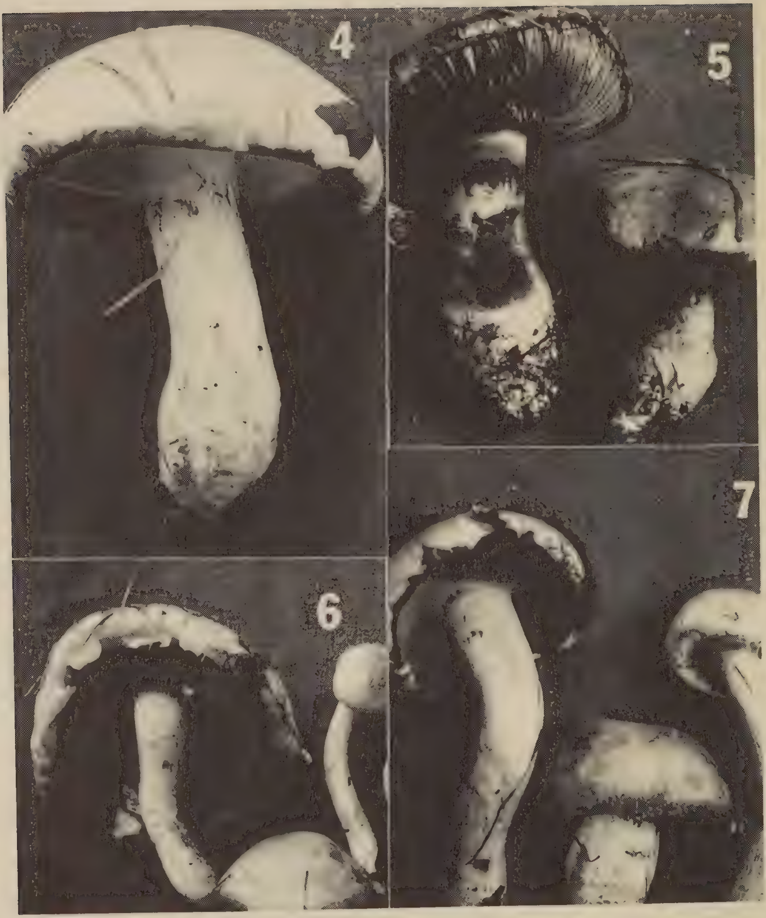
Our taxon would be placed in subsection Multiformes if odor were the only consideration, but is placed in Rapacei for other characters (Moser 1978). Also in subsection Multiformes, Phlegmacium talus (Fr.) Blytt (C. talus Fr.) as described in Die Gattung Phlegmacium (Moser 1960) is characterized by an ochre-brown to reddish-brown cap similar to the more highly colored caps in this subsection. It is a large species with a slightly inrolled margin (ours is distinctly inrolled), the smell is sweet (orange blossom to Kunsthonigartig--honeylike) similar to ours, spores 8.5-10(-11) x 4.8-5.5 µm are somewhat small in size, overlapping ours, but it has an abrupt bulb unlike ours. P. talus (Fr.) Blytt occurs in beechwood on calcareous soil in Europe which is different from ours. C. ochropallidus R. Hry. in the Multiformes group has a pallid cap similar to our taxon, but is less robust, cap 4-7 cm, has a bluntly abrupt bulb, and spores 11-11.5 x 5.5-6 µm somewhat larger than ours, with no odor.

In summary, Moser in Singer (1986) places these related taxa in Phlegmacium Subsection Multiformes Henry ex Moser. Stirps Multiformis contains C. multiformes (Fr. ex Secr.) and C. talus Fr., and Stirps Rapaceus contains C. amarescens (Mos. ex Mos.) Moser, C. rapaceus Fr., and C. albidus Peck. The latter stirps best fits our taxon because of cap color, however, other taxa with a sweet odor are found in Stirps Multiformis.

There is little doubt that our taxon is part of this complex of species. It is the only species in the complex associated with Populus tremuloides. The closest taxon in size, coloration, and spore size is C. talus (Fr.) Blytt, and especially noted is the sweet smell. C. hedyaromaticus has a very pallid (almost white) colored cap, a distinctly inrolled margin, is the most robust species in the complex, has large spores, a sweet smell, mild taste (only slightly bitter at times), and is the only taxon of the group reported to be associated with Populus tremuloides in North America.



Figs. 1-3. *Cortinarius hedyaromaticus*. 1. basidia 30-40 x 8-10 µm. 2. basidiospores 9.5-11(-13) x 5.5-6.5(-7.5) µm. Scale bar = 10 µm. 3. sporocarp 1/4 natural size.



Figs. 4-7. Cortinarius hedyaromaticus. 4. inrolled margin and enlarged non-marginate stipe base (3/4 actual size). 5. older specimens showing gray-violet statining reaction at stipe apex (1/2 natural size). 6. appendiculate margin and subdecurrent gills (1/2 natural size). 7. membranous veil on younger specimen (1/2 natural size.

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THE LICHEN FLORA OF ROCK CANYON, UTAH COUNTY, UTAH

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ABSTRACT

Sixty-three lichen species in thirty genera are reported for Rock Canyon, a steep, west-facing canyon in the Wasatch Mountains of central Utah. *Dimelaena thysanota, Acarospora boulderensis, Physcia dimidiata* and *Rinodina turfacea* are reported as new to Utah.

INTRODUCTION

Literature review of Utah lichenology

Utah lichenology began with Edward Tuckerman's 1871 report of 27 species and 8 varieties from various locations in the state (Tuckerman 1871). Until recent times, however, botanists and other collectors paid little attention to the lichen flora of Utah. Possibly the relative scarcity of showy macrolichens in the state discouraged serious floristic investigation.

Over eighty years after Tuckerman's initial report, Seville Flowers (1954) published a list of 127 lichen species in 27 genera. Flowers was a bryologist and his lichen collections were merely incidental to his statewide bryological investigations; but his collections indicated that Utah had a rich microlichen flora in need of more serious study.

Harry Nielsen (1960) completed "Lichens of the Wasatch Mountains in Central Utah" for his masters thesis at Brigham Young University. Nielsen's thesis included the first keys and formal descriptions of Utah lichens, and included 52 species and 2 varieties in 17 genera, with 33 species reported as new for Utah.

Anderson and Rushforth (1976) published the first of many studies on cryptogamic soil crusts in Utah's arid to semiarid habitats. They reported 17, mostly terricolous lichen species, in

11 genera. As part of an air quality survey commissioned by the National Park Service for the southern portion of Zion National Park, Nash and Sigal (1981) reported 159 lichen species in 53 genera, 4 of which were new to Utah.

St. Clair (1984) studied lichen communities along an alpine tundra ridge in the Uinta Mountains of northeast Utah, and reported 66 species, 16 of which were new to the state. St. Clair and Warrick (1987) reported *Acarospora nodulosa* (Duf.) Hue. var. *nodulosa* from gypsiferous soils in southern Utah as a new record for North America.

Recently, a comprehensive literature review of the lichens of Utah, based on reports in 44 papers, was published (St. Clair et al. 1991). A total of 85 genera, 318 species, and 11 varieties have been reported for Utah. Based on lichenological investigations throughout the state and in conjunction with the publication of the catalog, Newberry and St. Clair (1991) reported an additional 72 species in 45 genera as new to the state. This brought the total number of Utah lichens to 390.

Newberry (1991) described the lichen flora of the Uinta Moutains, and reported 291 taxa in ninety-five genera from his study. St. Clair and others are currently completing a floristic survey of the lichens of Timpanogos Cave National Monument, Utah and to date have identified 72 species in 29 genera for the monument.

Few lichen ecology studies have been conducted in the state of Utah. One of the first papers on this subject dealt with lichen community structure in Zion National Park (Rushforth et al 1982). Cluster analyses and Shannon-Weaver diversity indices were used to analyze field data and characterize lichen community structure in the park. St. Clair's thesis, referenced above, characterized lichen communities along an elevational gradient in the Uinta Mountains (St. Clair 1984). This study assessed the influence of vascular plant cover, rock cover, soil development, grazing and snow-melt patterns on the distribution of alpine tundra lichens. A study considering the influence of microhabitat on species diversity, distribution and abundance of corticolous lichens in Zion National Park was completed in the mid 1980s (St. Clair et al 1986).

Description of study site

Rock Canyon is located in Utah County, 63 km south of Salt Lake City, UT. Along with numerous side canyons, Rock Canyon cuts 4 km through the Wasatch Mountains from east to west and opens to the west at approximately 40° 16' north latitude, 111° 37' west longitude. Elevation in the canyon bottom ranges from 2134 m in the upper gorge to 1524 m at the mouth of the canyon.

Sequentially from the canyon's river bed the stratigraphy consists of Tintic Quartzite, Pre-Cambrian Tillite, and Great Blue Limestone.

Vascular plant communities in Rock Canyon vary with elevation and proximity to water. The Mountain brush community in the lower elevations includes gambel oak (*Quercus gambelii*), bigtooth maple (*Acer grandidentatum*), serviceberry (*Amelanchier alnifolia*), two species of mountain mahogany (*Cercocarpus ledifolius* and *Cercocarpus intricatus*), and big sagebrush (*Artemisia tridentata*). The riparian community includes narrowleaf cottonwood (*Populus angustifolia*), water birch (*Betula occidentalis*), thinleaf alder (*Alnus incana*), box elder maple (*Acer negundo*), red-osier dogwood (*Cornus sericea*), horsetail (*Equisetum hyemale*), willow (*Salix scouleriana*), and some big sagebrush (*Artemisia tridentata*). The upslope juniper community includes Utah juniper (*Juniperus osteosperma*), and big sagebrush (*Artemisia tridentata*), usually on steep, well-drained exposed slopes. Middle elevations are characterized by quaking aspen (*Populus tremuloides*), big sagebrush (*Artemisia tridentata*), and lodgepole pine (*Pinus contorta*). Higher elevations are characterized by englemann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*) and lodgepole pine (*Pinus contorta*).

Uinta National Forest administers Rock Canyon, protects it as a critical watershed, prohibits motorized vehicle use in the canyon and maintains a primitive foot trail. In recent years civic groups have proposed that Rock Canyon be managed more comprehensively for natural research and low-impact recreation.

METHODS

As lichen distribution is influenced by substrate, moisture and sunlight, all available substrates and habitats in the canyon have been carefully sampled. Small amounts of each species from each substrate and habitat were collected. Specimens were removed directly from the substrate where possible, or depending on the species, sometimes attached to small pieces of bark, soil, or rock.

Specimens were placed in carefully labeled paper sacks and taken to the BYU Herbarium of Nonvascular Cryptogams, where they were curated and placed in permanent herbarium packets labeled with site, habitat and substrate information. Species were identified using standard lichen keys and taxonomic treatises. Standard chemical spot tests and, where necessary, thin-layer chromatography techniques were used to finalize species identifications.

RESULTS

Sixty-three lichen species in thirty genera are reported from Rock Canyon. *Acarospora boulderensis, Dimelaena thysanota, Physcia dimidiata,* and *Rinodina turfacea* are reported as new for Utah. Specimens are deposited in the Herbarium of Nonvascular Cryptogams at Brigham Young University (BRY).

Following is an alphabetic list of all lichen species collected in Rock Canyon. The species are followed by the BRY herbarium number, substrates, and relative abundance. Species marked with an asterisk are new state records.

*ACAROSPORA BOULDERENSIS Magnusson. BRY C21815. Rare. On quartzite.

ACAROSPORA GLAUCOCARPA (Ach.) Körber. BRY C21883. Rare. On limestone.

ACAROSPORA STRIGATA (Nyl.) Jatta. BRY C21884. Rare. On limestone.

ASPICILIA CALCAREA (L.) Mudd. BRY C21885, BRY C21886, BRY C21887. Rare to common. On limestone.

ASPICILIA CINEREA (L.) Körber. BRY C22391. Rare to common. On quartzite.

ASPICILIA DESERTORUM (Krempelh.) Mereschk. BRY C21888, BRY C21889. Rare to common. On limestone.

CALOPLACA CITRINA (Hoffm.) Th. Fr. BRY C21890. Rare. On limestone.

CALOPLACA HOLOCARPA (Hoffm.) Wade. BRY C21891. Common. On bark of narrowleaf cottonwood.

CALOPLACA TRACHYPHYLLA (Tuck.) Zahlbr. BRY C21892. Common. On limestone.

CANDELARIELLA DEFLEXA (Nyl.) Zahlbr. BRY C21893, BRY C21894. Common. On bark of narrowleaf cottonwood, and gambel oak.

CANDELARIELLA ROSULANS (Müll. Arg.) Zahlbr. BRY C21895. Common. On quartzite.

CATAPYRENIUM GRANULOSUM (B. de Lesd.) Thomson. BRY C21896. Rare. On limestone.

CATAPYRENIUM LACHNEUM (Ach.) R. Sant. BRY C21897. Rare. On soil over limestone.

COLLEMA COCCOPHORUM Tuck. BRY C21898. Rare. On limestone.

COLLEMA FLACCIDUM (Ach.) Ach. BRY C21899, BRY C21900. Rare to common. On limestone.

COLLEMA POLYCARPON Hoffm. BRY C21901. Rare. On limestone.

DERMATOCARPON INTESTINIFORME (Körber) Hasse. BRY C21902, BRY C22390. Rare. On quartzite.

DERMATOCARPON MINIATUM (L.) Mann. BRY C21903, BRY C21904. Common to abundant. On limestone.

DERMATOCARPON RETICULATUM Magnusson. BRY C21905. Common. On limestone.

DIMELAENA OREINA (Ach.) Norman. BRY C21906. Common. On quartzite.

*DIMELAENA THYSANOTA (Tuck.) Hale & Culb. BRY C21677. Rare. On quartzite.

DIPLOTOMMA ALBOATRUM (Hoffm.) Flotow. BRY C21907. Rare. On limestone.

FULGENSIA FULGENS (Swartz) Elenkin. BRY C21908. Rare. On soil over limestone.

GONOHYMENIA NIGRITELLA (Lettau) Henssen. BRY C21909. Rare. On limestone.

HYPERPHYSCIA ADGLUTINATA (Flörke) H. Mayrh. & Poelt. BRY C21940. Common. On bark of gambel oak.

LECANORA DISPERSA (Pers.) Sommerf. BRY C21910. Rare. On quartzite.

LECANORA HAGENI (Ach.) Ach. BRY C21911, BRY C21912. Common. On bark of narrowleaf cottonwood, and gambel oak.

LECANORA MURALIS (Schreber) Rabenh. BRY C21913. Rare on lignum. This is an unusual substrate for *L. muralis*. Ordinarily this species occurs on rock but in western North America it occasionally appears on lignum of various conifers.

LECANORA THALLOPHILA Magnusson. BRY C21914. Rare. On *Dermatocarpon intestiniforme*.

LECIDEA LEUCOTHALLINA Arnold. BRY C21915. Common. On quartzite.

LECIDEA TURGIDULA Fr. BRY C21916. Rare. On bark of narrowleaf cottonwood.

LECIDELLA STIGMATEA (Ach.) Hertel & Leuck. BRY C21939. Rare to common. On limestone.

LEPRARIA INCANA (L.) Ach. BRY C21917. Rare. On moss.

MEGASPORA VERRUCOSA (Ach.) Hafellner & Wirth. BRY C21918, BRY C21919. Rare to common. On soil, and moss over quartzite.

PELTIGERA CANINA (L.) Willd. BRY C21920. Common. On moss over rock.

PHAEOPHYSCIA CILIATA (Hoffm.) Moberg. BRY C21921. Rare. On bark of douglas fir.

PHAEOPHYSCIA ENDOCOCCINA (Körber) Moberg. BRY C21922. Rare. On quartzite.

PHAEOPHYSCIA NIGRICANS (Flörke) Moberg. BRY C21923. Rare to common. On bark of narrowleaf cottonwood.

PHAEOPHYSCIA ORBICULARIS (Necker) Moberg. BRY C21924, BRY C21925, BRY C21926, BRY C21927, BRY C21928, BRY C21929, BRY C21930, BRY C21931, BRY C21932. Common to abundant. On bark of narrowleaf cottonwood, bigtooth maple, shaded limestone, limestone, quartzite, moss over quartzite, moss over limestone, moss.

PHYSCIA CAESIA (Hoffm.) Fürnr. BRY C21933, BRY C21934. Rare to common. On moss over quartzite, quartzite.

*PHYSCIA DIMIDIATA (Arnold) Nyl. BRY C21935. Rare. On bark of gambel oak.

PHYSCIA DUBIA (Hoffm.) Lettau. BRY C21936, BRY C21937, BRY C21938. Common. On bark of bigtooth maple, quartzite, moss.

PHYSCIA TENELLA (Scop.) DC. *in* Lam. & DC. BRY C21939. Rare. On limestone.

PHYSCONIA DETERSA (Nyl.) Poelt. BRY C21941. Rare. On moss over quartzite.

PHYSCONIA GRISEA (Lam.) Poelt. BRY C21942, BRY C21943, BRY C21944. Rare. On bark of gambel oak, moss.

PHYSCONIA MUSCIGENA (Ach.) Poelt. BRY C21946, BRY C21947, BRY C21948, BRY C21949. Rare to common. On limestone, soil, moss, moss over quartzite.

PSORA TUCKERMANII R. Anderson *ex* Timdal. BRY C21950. Common. On soil over limestone.

RHIZOCARPON GEMINATUM Körber. BRY C21951, BRY C21952. Common. On quartzite.

RHIZOPLACA MELANOPHTHALMA (DC. *in* Lam. & DC.) Leuck. & Poelt. BRY C21953, BRY C21954. Rare to common. On limestone and quartzite.

RHIZOPLACA PELTATA (Ramond) Leuck. & Poelt. BRY C21955. Rare to common. On quartzite.

RINODINA BISCHOFFII (Hepp.) Massal. BRY C21956. Rare. On limestone.

RINODINA PYRINA (Ach.) Arnold. BRY C21957, BRY C21958, BRY C21959. Rare to common. On bark of bigtooth maple, narrowleaf cottonwood and gambel oak.

*RINODINA TURFACEA (Wahlenb.) Körber. BRY C22392. Rare. On bark of douglas fir.

TONINIA CAERULEONIGRICANS (Lightf.) Th. Fr. BRY C21960, BRY C21961. Rare. On soil, and moss over limestone.

UMBILICARIA PHAEA Tuck. BRY C21962. Common to abundant. On quartzite.

UMBILICARIA TORREFACTA (Lightf.) Schrader. BRY C21963. Rare. On limestone.

UMBILICARIA VIRGINIS Schaerer. BRY C21964, BRY C21965. Rare. On quartzite and limestone.

VERRUCARIA MURALIS Ach. BRY C21966. Rare. On limestone.

XANTHOPARMELIA PLITTII (Gyelnik *ex* D. Dietr.) Hale. BRY C21967, BRY C21968. Rare to common. On moss over quartzite and quartzite.

XANTHORIA CANDELARIA (L.) Th. Fr. BRY C21969. Rare to common. On bark of narrowleaf cottonwood.

XANTHORIA ELEGANS (Link) Th. Fr. BRY C21970, BRY C21971, BRY C21972, BRY C21973. Rare to common. On quartzite, limestone and moss.

XANTHORIA FALLAX (Hepp *in* Arnold) Arnold. BRY C21974, BRY C21975. Abundant. On bark of gambel oak and moss.

XANTHORIA POLYCARPA (Hoffm.) Rieber. BRY C21976, BRY C21977, BRY C21979, BRY C21981. Abundant. On bark of bigtooth maple, narrowleaf cottonwood, gambel oak and lignum.

CONCLUSIONS

The lichen flora of Rock Canyon is rich and diverse. The foliose, squamulose and crustose lichen flora of Rock Canyon is typical of semiarid montane regions of the Intermountain Area. The absence of fruticose species is not unusual for Utah. Poor air quality conditions in Utah Valley are not reflected in the lichen flora of Rock Canyon. This is likely a result of regular outwash of air down the canyon to the valley floor.

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MYCOTAXON

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VALIDATION OF THE NAME MICROBOTRYUM VINOSUM (USTILAGINALES)

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SUMMARY

The fungal name *Microbotryum vinosum* (L.–R. & C. Tul.) G. Deml & Prillinger was not validly published. The new combination is thus proposed here. This smut is reported as new to Bulgaria.

The combination *Microbotryum vinosum* (L.–R. & C. Tul.) G. Deml & Prillinger in Prillinger, Deml, Doerfler, Laaser, & Lockau (*Bot. Acta* **104**: 10. 1991) is illegitimate according to Article 33.2 of the International Code of Botanical Nomenclature (no reference to the basionym).

Microbotryum vinosum (L.–R. & C. Tul.) Denchev, *comb. nov.*
Basionym: *Ustilago vinosa* L.–R. & C. Tul., *Ann. Sci. Nat. Bot.*, *sér.* 3, **7**: 96. 1847.
Synonym: *Uredo vinosa* Berk. in litt. ad Tul. (nom. nud.).

The smut is reported here as new to Bulgaria: mt. Rila, supra lacum Băbreka, 2650 m s.m., 42° 12' N, 23° 18' E, 22.vii.1909, B. Davidov, SOM 21 017–M. Matrix: *Oxyria digyna* (L.) Hill. Spores (6.5–) M±σ = 7.8±0.6 (–10)× (6.5–) M±σ = 7.3±0.5 (–9) µm (N=100).

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NEW SPECIES OF *GYMNOPILUS* (AGARICALES, CORTINARIACEAE) FROM MEXICO

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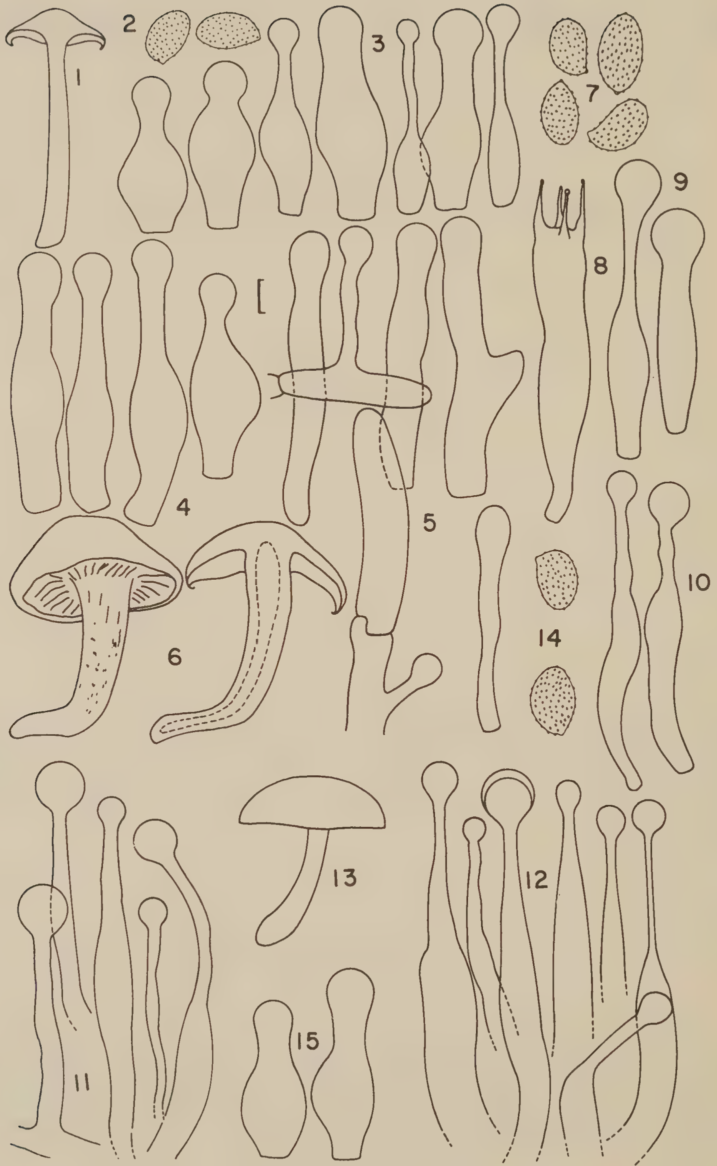
SUMMARY

Six new species of *Gymnopilus* from Mexico are described, as follow: *G. hemipenetrans* from the State of Chiapas, *G. commune, G. galerinopsis, G. medius* and *G. tuxtlense* from the State of Veracruz and *G. robustus* from the State of Nayarit. This paper is part of the monograph on Mexican species of *Gymnopilus* that is preparing the author.

INTRODUCTION

Continuing the research on the genus *Gymnopilus* from Mexico, started by the author seven years ago (Guzmán-Dávalos & Guzmán, 1986, 1991), several specimens from the Herbaria XAL and IBUG were found that do not fit with the known species, so they are described as new taxa, before to present the monograph on the Mexican species that it is in preparation.

Microscopic study was made with 5% KOH, Melzer's reagent and congo red. Color of microscopic structures indicated in descriptions was the one observed in KOH. Ornamentation of spore wall is included in spore measures.



Figs. 1-15. 1-5: *Gymnopilus commune*, 1: basidiome, 2: spores, 3: pleurocystidia, 4: cheilocystidia, 5: caulocystidia (all from Guzmán 30481, type). 6: *G. galerinopsis*, basidiomata (Villarreal 2684, type). 7-12: *Gymnopilus galerinopsis*, 7: spores, 8: basidium, 9: pleurocystidia, 10: cheilocystidia, 11: pileocystidia, 12: caulocystidia (all from Villarreal 2684, type). 13-15: *G. hemipenetrans*, 13: basidiome, 14: spores, 15: pleurocystidia, type b (all from Guzmán 30519, type)(bar: 1, 6 & 13 = 10 mm, 2-5, 7-12 & 14-15 = 4 μm).

DESCRIPTIONS OF THE TAXA

Gymnopilus commune Guzmán-Dávalos, **sp. nov.**
Figs. 1-5

Pileus circa 30 mm diametro, convexo-campanulatus, vel umbonatus, glabrus ad tenuis fibrillosus, aurantiaco-brunneolus. Lamellae adnatae, subconfertae, angustae, luteo-aurantiaco. Stipes circa 58 X 5-6 mm, cylindraceus, centralis, pileo concoloro vel pallidus, velum fibrillosum, zona annular formare. Contextum albidus vel brunneo-aurantiacus irregulariter. Sporae 6-8.4 X 4-4.8 μm, ellipsoidae, verruculosae, dextrinoidae. Pleurocystidia 16-28 X 3.2-9.6 μm, ampullacea vel ventricosa, subcapitata vel capitata, hyalina vel flavida, copiosa. Cheilocystidia 20.8-40 X 4-8 μm, cylindrico-ventricosa, cylindracea vel ampullacea, capitata vel subcapitata, hyalina vel flavida. Trama pileus radiata. Pileocystidia nulla. Caulocystidia 16-44.8 X 1.6-5.6 μm, cylindracea vel cylindrico-ventricosa, capitata vel subcapitata. Fibuligerus. Lignicola ad Pinus-Quercus sylva, Veracruz, prope Cumbres de Acuitzingo, Puerto del Aire. Holotypus Guzmán 30481 (XAL).

Pileus aprox. 30 mm diam., campanulate convex, with a broad umbo, more or less glabrous to finelly fibrillose, brownish orange or tanned orange. Lamellae adnate, subclose, narrow, mustard orange yellow, with a yellowish pruinose edge. Stipe aprox. 58 X 5-6 mm, equal or ligthly expanded to the base, central, striate-fibrillose, concolor with the pileus or ligther especially in the apex and in the base, being yellowish white, solid, with fibrillose remnants from the veil forming an annular zone. Whitish mycelia in the stipe base. Context whitish to irregularly orange brown, odour fungoid.

Spores 6-8.4 X 4-4.8 μm, ellipsoid, with subthick wall, verruculose, without germ pore, yellowish brown, dextrinoid. Basidia scarce, aprox. 24.8 X 7.2 μm, tetraspored, sterigmata 3.2 μm long., clavate, hyaline or with yellowish or yellowish brown content. Pleurocystidia 16-28 X 3.2-9.6 μm, apex 2.4-5.6 μm diam., flask-shaped or ventricose, with long or short neck, subcapitate or capitate, sometimes non capitate, hyaline or with yellowish content, very abundant, sometimes clustered. Cheilocystidia 20.8-40 X 4-8 μm, apex 3.2-5.6 μm diam., cylindric-ventricose, cylindrical or flask-shaped, capitate or subcapitate, hyaline or with yellowish content. Hymenophoral trama subparallel, hyphae with thin wall. Pileus trama radial. Cuticle with hyphae 2.8-8 μm diam., postrate, yellowish brown with incrusted walls. Pileocystidia absent. Caulocystidia 16-44.8 X 1.6-5.6 μm, apex 3.6-5.2 μm diam., cylindrical or cylindric-ventricose, capitate or subcapitate, sometimes non capitate, frequently branched, hyaline or with yellowish content, found only in the stipe apex in tufts. Clamp connections present. A light yellowish brown pigment is dissolved when mounted in KOH.

HABITAT. Solitary on wood, in a *Pinus-Quercus* forest.

EXAMINED SPECIMEN. VERACRUZ, Orizaba-Tehuacán road, Cumbres de Acuitzingo, Puerto del Aire (IV Exhibition of Mushrooms from Córdoba, Ver.), Jul. 24, 1992, **Guzmán 30481** (XAL, holotype; IBUG, isotype).

OBSERVATIONS. This species is characterized by the glabrous pileus, completly brownish orange, long stipe, whitish context that changes to orange brown and for having pleurocystidia clustered, many of them with a narrow and long neck. It is related with *G. subsapineus* Hesler, but it is distinguished by the yellowish context, white stipe, bigger spores, of 7-9(-10) X 4.5-5.5 μm from the type study [but 6-8.5 X 4.5-5 μm sensu Hesler (1969)] and also bigger pleurocystidia, of 21-38 X 5-8(-12) μm in type material [25-28(-42) X 5-7 μm sensu Hesler], furthermore the pleurocystidia do not have long and narrow neck (Hesler, 1969). *G. commune* is also close with *G. longipes* Guzmán-Dávalos & Guzmán for the stipe size, but the last one has close to subcrowded lamellae with a long decurrent tooth, spores little wider, inconspicuous pleurocystidia, shorter and wider cheilocystidia and has pileocystidia (Guzmán-Dávalos & Guzmán, 1986). *G. liquiritiae* (Pers. : Fr.)Karst. has bigger spores and pleurocystidia subcapitate and inconspicuous (Hesler, 1969; Guzmán-Dávalos & Guzmán, 1991). The name of the species is due to its common macroscopic habit.

Gymnopilus galerinopsis Guzmán-Dávalos, **sp. nov.**
Figs. 6-12

Pileus 30-50 mm diametro, convexus vel convexo-campanulatus, glabrus, fibrillosus ad areolatus, aurantiaco-rubeolus ad luteo- aurantius. Lamellae sinuatae, subdistantes, latae, aurantiaco ad aurantiaco-rubeolus. Stipes 35-58 X 5-13 mm, cylindraceus, centralis, cum pileo concolor vel pallide. Contextum aurantiaco-rubeolum in pileus, brunneo aurantiacus in stipes. Sporae (6-)6.4-9.6 X 4.4-4.8(-5.6) μm, ellipsoidae, verrucosae, dextrinoidae. Pleurocystidia 25.6-34.4 X 4.4-4.8 μm, tibiiforma ad cylindrico-ventricosa capitata, hyalina, vel brunneo-lutea, infrequens. Cheilocystidia 28-44 X 3.2-4.8 μm, tibiiforma, hyalina vel brunneo- aurantiaca. Trama pileus radiata. Pileocystidia 1.2-4.8 μm diametro, tibiiforma, copiosa. Caulocystidia 2.8-6.4 μm diametro, tibiiforma, aliquot cum collo filiform. Fibuligerus. Lignicola ad Pinus-Abies sylva, Veracruz, prope Cofre de Perote, Los Gallos. Holotypus Villarreal 2684 (XAL).

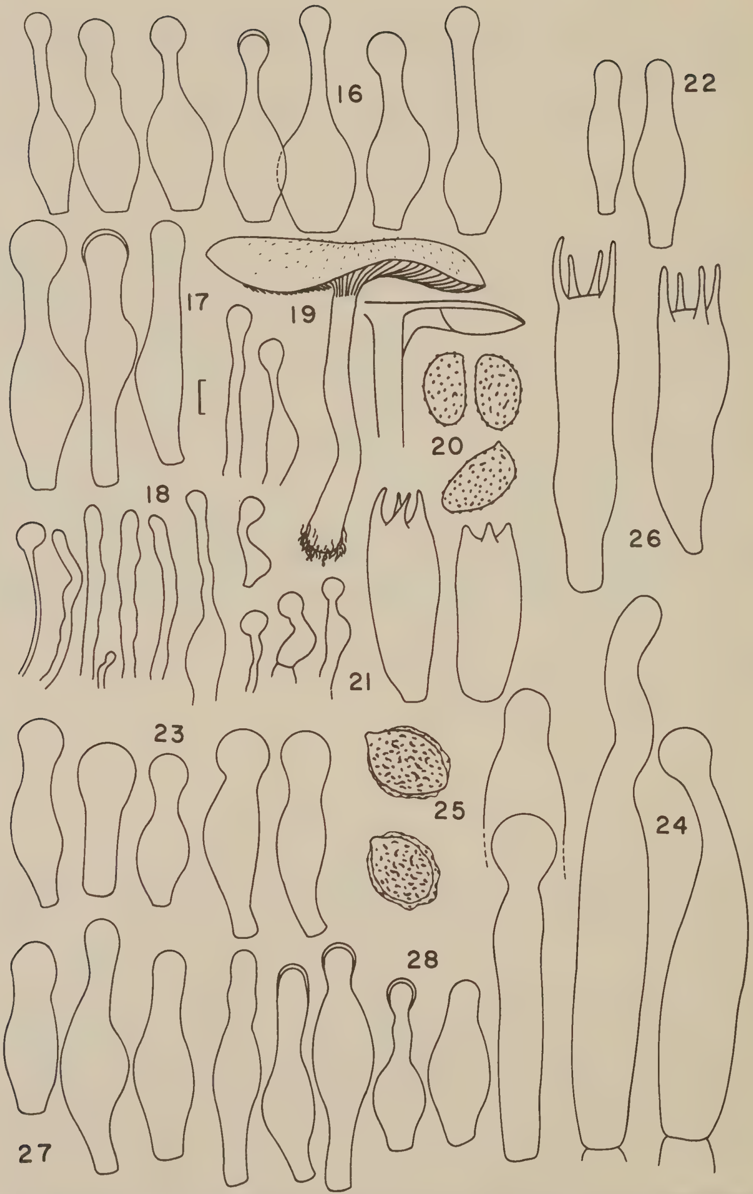
Pileus 30-50 mm diam., convex to campanulate-convex, glabrous or ligthly wrinkled, fibrillose or areolate under lens, reddish orange or orange yellow, brick color when dry. Lamellae sinuate, sometimes with a decurrent tooth, subdistant, broad, light orange to reddish orange when mature, margin smooth. Stipe 35-58 X 5-13 mm, terete, broader to the apex and narrower to the base, central, fibrillose, concolor with the pileus or ligther, base yellowish white, hollow. Veil not seen. Context thick, reddish orange in pileus, orange brown in stipe and reddish in stipe base. KOH stains dry pileus and stipe reddish black and context dark vinaceus red.

Spores (6-)6.4-9.6 X 4.4-4.8(-5.6) μm, ellipsoid to ovoid, with subthick wall, verrucose, without germ pore, yellowish brown, dextrinoid (brown with reddish orange tinges in Melzer's reagent). Basidia 26.4-41.6 X 5.6-7.2 μm, tetraspored, some bispored, sterigmata 0.8-5.6 μm long., clavate to cylindric-clavate, with or without central constriction, hyaline or with yellowish or yellowish brown content. Basidioles very abundant, with yellowish brown or orange yellowish brown content. Pleurocystidia 25.6-34.4 X 4.4-4.8 μm, apex 2.4-6.4 μm diam., tibiiform or cylindric-ventricose capitate, hyaline or with grayish yellow or yellowish brown content, very rare and incospicuous. Cheilocystidia 28-44 X 3.2-4.8 μm, apex 2.4-4.4 μm diam., tibiiform, hyaline, or with yellowish, yellowish brown or orange brown content. Heteromorphous gill edge and fertile. Hymenophoral trama subparallel, hyphae with thin wall, yellowish. Pileus trama radial, hyphae with thin wall, yellowish. Cuticle with hyphae 3.2-5.6 μm diam., postrate, with yellowish or dark yellowish brown content. Pileocystidia 1.2-4.8 μm diam., apex 2-6.4 μm diam., tibiiform, with yellowish or dark yellowish brown content, abundant. Caulocystidia 2.8-6.4 μm diam., apex 2.6-6.4 μm diam., tibiiform, some with filiform neck, with a cylindrical base prolonged among the context hyphae, sometimes with subthick wall, especially in the apex and neck, hyaline or with yellowish or yellowish brown content, present in all stipe long, including the white base, in palisade in the apex, in tufts or dispersed in the rest, abundant. Clamp connections present. Lactiferous hyphae present. A yellowish pigment is dissolved when mounted in KOH.

HABITAT. Gregarious, lignicolous in a *Abies-Pinus* forest.

EXAMINED SPECIMEN. VERACRUZ, Mpio. of Xico, E zone of Cofre de Perote, 1.5 km N from Ingenio El Rosario, Los Gallos, alt. 2830 m, Oct. 8, 1986, **Villarreal 2684** (XAL, holotype; IBUG, isotype).

OBSERVATIONS. *G. galerinopsis* is defined for having all the cystidia (pleuro-, cheilo-, pileo- and caulocystidia) tibiiform, to present caulocystidia all the stipe long and by the pileus color. Because of the tibiiform cystidia it is very close to the genus *Galerina*, but this has spores with plage or in case that do not have plage the clamp connections are absent; furthermore the *Galerina* basidioma reaction with KOH is negative (Singer, 1986). By the basidioma color and glabrous pileus, *G. galerinopsis* is related with *G. oregonensis* Murr. and *G. picreus* (Pers. : Fr.)Karst. sensu auct., non Hesler, but it is distinguished by the pleuro- and cheilocystidia flask-shaped or ventricose, capitate or subcapitate in those species (Hesler, 1969; Bon, 1987; Höiland, 1990).



Figs. 16-28. 16-18: *Gymnopilus hemipenetrans*, 16: pleurocystidia, type a, 17: pleurocystidia, type c, 18: cheilocystidia (all from Guzmán 30519, type). 19-21: *G. medius*, 19: basidiome, 20: spores, 21: basidia (all from García-Franco s.n., type). 22-24: *Gymnopilus medius*, 22: pleurocystidia, 23: cheilocystidia, 24: caulocystidia (all from García-Franco s.n.). 25-26: *G. robustus*, 25: spores, 26: basidia (both from Vargas 19, type). 27-28: *Gymnopilus robustus*, 27: pleurocystidia, 28: cheilocystidia (all from Vargas 19, type)(bar = 4 μm, except in 18 = 5 μm, 19 = 10 mm).

Gymnopilus hemipenetrans Guzmán-Dávalos, **sp. nov.**
Figs. 13-18

Pileus circa 45 mm diametro, convexus ad planus, glabrus, aurantiaco-flavidus ad aurantiaco-brunneus. Lamellae adnatae, confertae, subangustae, aurantiaco-ferruginae vel brunneo- ferruginae. Stipes circa minus 50 X 5-8 mm, subbulbosus, subcentralis, apicis subalbidus, pileo concoloro ceterum, velum evanescens. Contextum flavidum. Sporae 6-8.8 X 4.4-5.6 μm, ellipsoidae vel latus ellipsoideae, verrucosae, dextrinoidae. Pleurocystidia hyalina vel brunneo-lutea, heteromorphous in tres typus, a) 20.8-31.2 X 5.2-8.8 μm, ampullacea, longicollo, capitata vel subcapitata et copiosa, b) 17.6-21.6 X 7.2-8 μm, ampullacea, brevicollo, capitata vel subcapitata et infrequens, et c) 28-36 X 5.2-8.8 μm, ampullacea vel cylindrico-ventricosa et infrequens. Cheilocystidia 0.8-6.1 μm diametro, filiforme, submoniliforme, ventricosa vel ampullacea, hyalina vel lutea. Trama pileus radiata. Pileocystidia et caulocystidia nulla. Fibuligerus. Lignicola ad tropicalis sylva, Chiapas, prope Laguna Belgica. Holotypus Guzmán 30519 (XAL).

Pileus aprox. 45 mm diam., convex to convex-plane, glabrous, lightly fibrillose under lens, dry, yellowish orange to brownish orange. Lamellae adnated, close, subnarrow, rusty orange to rusty brown. Stipe aprox. 50 X 5-8 mm, terete, subbulbous, almost central, fibrillose to even, yellowish white in the apex, the rest concolor with the pileus, hollow, with fibrillose remnants from the veil. Context more or less thick, yellowish, taste bitter (when dry). KOH stains dry pileus orange brown.

Spores 6-8.8 X 4.4-5.6 μm, ellipsoid to widely ellipsoid, with subthick wall, verrucose, without germ pore, yellowish brown, dextrinoid (discoloring to yellowish or changing to light reddish brown in Melzer's reagent). Basidia 20.8-28.8 X 5.6-8.4 μm, tetraspored, some mono-, bi- or trispored, sterigmata 2.4-5.6 μm long., clavate, with or without central constriction, hyaline or with yellowish or yellowish brown content. Basidioles abundant, hyaline or with yellowish or yellowish brown content. Pleurocystidia of three types: a) 20.8-31.2 X 5.2-8.8 μm, apex 3.2-4.4 μm diam., abundant, gregarious or in small tufts, seldom isolated, flask-shaped, long-necked, capitate or subcapitate, sometimes with a thickening in the apex wall, many hyaline, some with the apex or part yellowish or brown; b) 17.6-21.6 X 7.2-8 μm, apex 4.4-5.6 μm diam., solitary, rare, flask-shaped, wide and short-necked, capitate or subcapitate, hyaline or with yellowish or yellowish brown content, and c) 28-36 X 5.2-8.8 μm, apex 4-6.4 μm, only present very near from the lamellae edge, rare, flask-shaped or cylindric-ventricose, non capitate, sub- or capitate, hyaline or with yellowish, yellowish brown or orange brown content, many with a thickening in the apex wall or a content secretion. Cheilocystidia 0.8-6.1 μm diam. (only the ends were observed), filiform, submoniliform, ventricose or flask-shaped, non capitate, sub- or capitate, apex 3.3-5 μm (in sub- and capitate), hyaline or yellowish. Hymenophoral trama subparallel, hyphae 7.2-31.2 μm diam., with thin to subthick wall. Pileus trama radial, hyphae 4.4-20 μm diam., with thin to subthick wall. Cuticle with hyphae 2.4-6.4 μm diam., postrate, yellowish, with incrusted walls. Pileocystidia and caulocystidia absent. Clamp connections present. Lactiferous hyphae present. An orange yellow pigment is dissolved when mounted in KOH.

HABITAT. Solitary on wood causing brown cubical rot, in a perennifolius tropical forest.

EXAMINED SPECIMEN. CHIAPAS, km 18 Ocozocuautla to Apicpac road, Laguna Bélgica (Exhibition of Mushrooms from Tuxtla Gutiérrez, Chiapas), Sept. 18, 1992, **Guzmán 30519** (XAL, holotype; IBUG, isotype).

OBSERVATIONS. This species is characterized for the three types of pleurocystidia, the filiform, submoniliform or flask-shaped cheilocystidia, absence of pileo- and caulocystidia and for its tropical habitat. Macroscopically it is very close to *G. penetrans* (Fr. : Fr.)Murr., differing by the adnated to subdecurrent lamellae, ventricose pleurocystidia, flask-shaped cheilocystidia and the presence of caulocystidia. Other related species by the pileus color and glabrous surface are *G. subsapineus* and *G. aurantiophyllus* Hesler; from the first one it is distinguished for its emarginate lamellae with a decurrent tooth, white stipe, cheilocystidia of different form and for the presence of caulocystidia. *G. aurantiophyllus* has a olive buff to yellowish context, lamellae staining rusty orange where bruised, pleuro- and cheilocystidia are of different form and also has caulocystidia. *G. aurantiacus* Hesler is near *G. hemipenetrans* in the filiform to subtibiiform cheilocystidia, but its pileus is fibrillose-scaly. Other related species is *G. stabilis* (Weinm.)Kühn. & Romagn., presenting spores with plage, pleurocystidia non capitate or subcapitate and grows in coniferous forest (Kühner & Romagnesi, 1953 & 1957; Hesler, 1969; Bon, 1987). None of the species mentioned present the variation in pleurocystidia observed in *G. hemipenetrans*. The brown cubical rot observed in this species was cited by Gilbertson (1974) for *G. sapineus* (Fr.)Maire.

Gymnopilus medius Guzmán-Dávalos, **sp. nov.**
Figs. 19-24

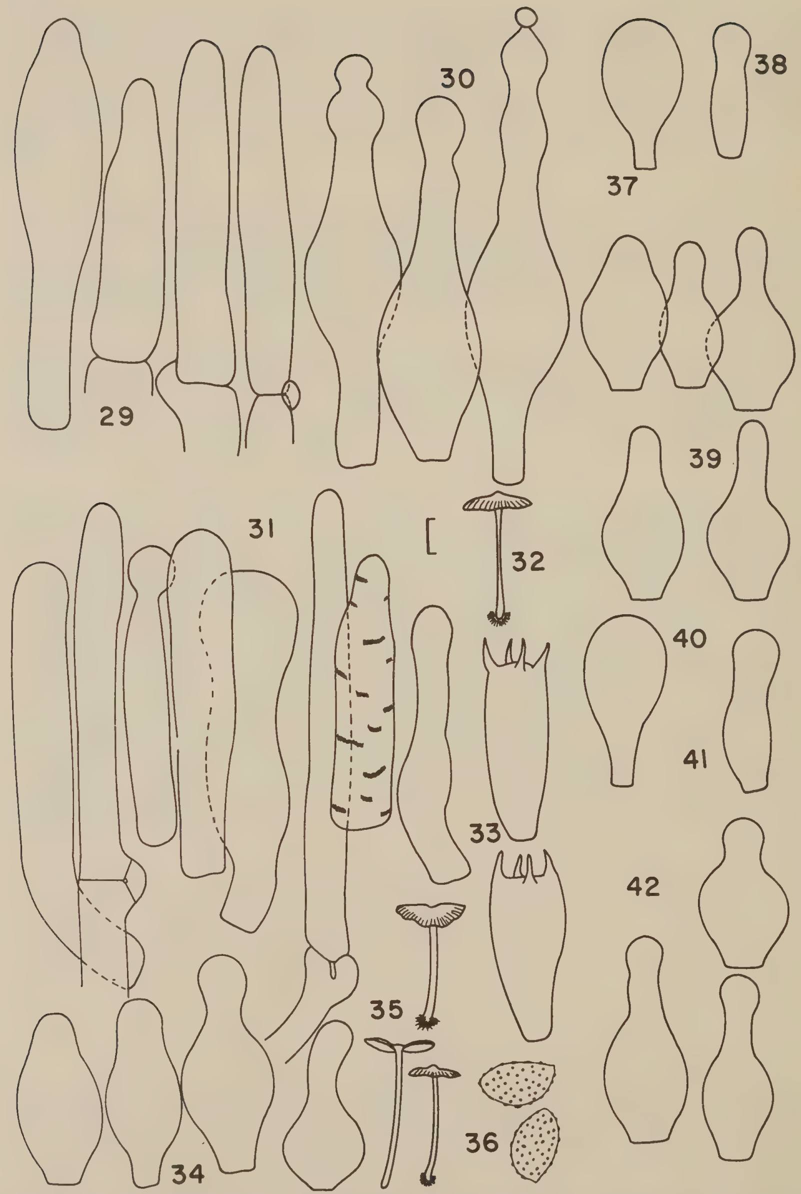
Pileus circa 80 mm diametro, convexus vel planus, fibrilloso-squamosus vel fibrilloso-appresus, flavido-brunneus, fibrillula rufobrunnea. Lamellae subdecurrens, confertae, latae, brunneo-ferruginae. Stipes circa 80 X 8 mm, centralis, fibrillosus, cremeus, fibrillula brunnea, vellum fibrillosum, zona anullar formare. Contextum albolutescens. Sporae (7.6-)8-10.4(-11.2) X (4.8-)5.2-6(-6.4) µm, ellipsoidae, verrucosae. Pleurocystidia 17.6-21.6 X 4-6 µm, ampullacea vel cylindrico-ventricosa, subcapitata vel non capitata, perrara. Cheilocystidia 17.6-24 X 5.2-7.2(-8) µm, *ampullacea, cylindracea vel cylindrico-ventricosa, subcapitata vel capitata, hyalina vel flavida. Trama pileus intricata. Pileocystidia nulla. Caulocystidia 40-64 (seu perlonga) X 5.6-10.4 μm, cylindracea, non capitata vel capitata. Fibuligerus. Lignicola ad tropicalis sylva, Veracruz, prope Estación Biológica El Morro de La Mancha. Holotypus García-Franco s.n. (XAL).*

Pileus aprox. 80 mm diam., convex to plane, decurved to straight margin, surface with appressed or some suberect fibrillose scales, arranged more or less in a concentric way, dry, brownish yellow to tanned brown, scales dark reddish brown. Lamellae subdecurrent, close, broad, lamelulla abundant, rusty brown, discoloring in some places to rusty brownish yellow. Stipe aprox. 80 X 8 mm, equal, base lightly wider, terete, somewhat flexuose, central, fibrillose, subfleshy to suberose, cream color, fibrilles light brown, solid, with fibrillose veil remnants forming an annular zone (not seen in dry material). Context yellowish white, staining yellow when exposed, odour and taste fungoid. Mycelia white. KOH stains pileus dark amber brown, almost black.

Spores (7.6-)8-10.4(-11.2) X (4.8-)5.2-6(-6.4) μm, ellipsoid, with subthick wall, verrucose, without germ pore, orange yellowish brown, probably dextrinoid (very few with reddish tinges in Melzer's reagent). Basidia 19.2-26.4 X 6-8 μm, tetraspored, sterigmata 0.8-3.2 μm long., shortly clavate, with or without central constriction, hyaline or with grayish yellow content. Basidioles 19.2-23.2(-30.4) X 7.2-10.8 μm, clavate, with dark yellowish brown content. Pleurocystidia 17.6-21.6 X 4-6 μm, apex 3.2-3.6 μm diam., flask-shaped or cylindric-ventricose, subcapitate or non capitate, hyaline, very rare, inconspicuous. Cheilocystidia 17.6-24 X 5.2-7.2(-8) μm, apex 4.8-6.4(-8.8) μm diam., flask-shaped, cylindric or cylindric-ventricose, subcapitate or capitate, hyaline or with light yellowish content, sometimes with brown content in the apex portion. Hymenophoral trama subparallel. Pileus trama interwoven. Cuticle with hyphae 3.2-20 μm diam., postrate to suberect, join in tufts to form the scales, yellowish or light brown, with or without incrusted walls. Pileocystidia absent. Caulocystidia 40-64 (to very long and difficult to measure) X 5.6-10.4 μm, apex 4.4-7.6 μm diam., cylindric, with or without the end narrowed, apex rounded or capitate, hyaline, found only in stipe apex in tufts. Clamp connections present. Lactiferous hyphae not observed. A dark yellowish pigment is dissolved when mounted in KOH.

HABITAT. Solitary, lignicolous, in a subcaducifolius tropical forest.

EXAMINED SPECIMEN. VERACRUZ, Mpio. of Actopan, Biological Station El Morro de La Mancha, April 19, 1990, **García-Franco s.n.** (XAL, holotype, IBUG, isotype).



Figs. 29-42. 29: *Gymnopilus robustus*, pileocystidia (Vargas 19, type), 30: *G. tuxtlense*, pleurocystidia, type b (Guzmán 19671, type). 31: *G. robustus*, caulocystidia (Vargas 19, type). 32-42: *G. tuxtlense*, 32: basidioma, 33: basidia, 34: cheilocystidia (all from Guzmán 19671, type), 35: basidiomata, 36: spores (both from Guzmán 19830), 37: basidiolum, 38: pleurocystidium, type a, 39: cheilocystidia (all from Guzmán 19830), 40: basidiolum, 41: pleurocystidium, type a, 42: cheilocystidia (all from Guzmán 19798)(bar = 4 μm, except 32 & 36 = 10 mm).

OBSERVATIONS. *G. medius* is characterized by the appresed fibrillose scaly pileus, decurrent lamellae and fibrillose remnants from the veil that form a fugacious annular zone; the pleurocystidia and cheilocystidia are relatively short, the pileus trama is interwoven and it has caulocystidia. It is close to *G. magnus* (Peck)Murr., *G. spectabilis* (Fr.)A.H.Smith and *G. magnificus* Guzmán-Dávalos & Guzmán; the first one has a bigger basidioma, pileus fibrillose to somewhat virgate, basidia and cheilocystidia bigger and pleurocystidia and caulocystidia are absent. *G. spectabilis* has a submembranous annulus and basidia, pleurocystidia and cheilocystidia bigger, also its taste is bitter. *G. magnificus* has subdistant lamellae, subglobose to ellipsoid spores, bigger basidia, napiform to piriform cheilocystidia, pileus trama radial and caulocystidia absent (Hesler, 1969; Mora & Guzmán, 1983; Guzmán-Dávalos y Guzmán, 1986).

Gymnopilus robustus Guzmán-Dávalos, **sp. nov.**
Figs. 25-29, 31

Pileus 70-90 mm diametro, convexus, plano-convexus vel campanulato-truncatus, pubescens ad fibrillose-subsquarrosus, subglabrus in aliquot portionis, exsiccata ochraceus. Lamellae sinuatae, confertae, ventricosae, exsiccata ochracea-fusca. Stipes 110-130 X 10-18 mm, basis subbulbosis 20-30 mm diametro, centralis ad excentralis, velum fibrillose, evanescens. Contextum flavidum. Sporae 9.6-11.6 X 7.2-8.8 μm, latus ellipsoidae, subglobosus ad limoniformae, verruculosae, dextrinoidae. Pleurocystidia 20-29.6 X 6-9.6 μm, ampullacea, subcapitata vel non capitata, hyalina vel lutea, perrara. Cheilocystidia 19.2-28.8 X 5.6-7.2 μm, ampullacea vel cylindrico-ventricosa, capitata vel non capitata, hyalina, infrequens. Trama pileus radiata. Pileocystidia 30.4-48 X 5.2-8.8 μm, cylindracea, lutea. Caulocystidia 29.6-56.8 X 4.4-8.4 μm, cylindracea, cylindrico-clavata, aliquot ventricosa, cylindrico-capitata vel subcapitata, lutea vel brunneo-lutea. Fibuligerus. Ad palma in tropicalis sylva, Nayarit, prope Las Varas. Holotypus Vargas 19 (IBUG).

Pileus 70-190 mm diam., convex, convex-plane to campanulate-truncated, with a straight or involute edge, pubescent to fibrillose-subsquarrose, some parts subglabrous, margin smooth, very thin, yellowish ochre when dry, probably rusty brown when fresh. Lamellae sinuate, with a decurrent tooth, close, ventricose, dark ochre when dry. Stipe 110-130 X 10-18 mm, more or less equal, base subbulbous of 20-30 mm diam., central to excentric, terete, solid. Veil fibrillose, evanescent, leaving ochre remnants on stipe apex. Context very thick in the disk, very thin to the margin, suberose when dry, yellowish. KOH stains dry pileus dark reddish brown.

Spores 9.6-11.6 X 7.2-8.8 μm, widely ellipsoid, subglobose to limoniform, verrucose, yellowish brown, warts imbibed in a well developed perisporium, without plage and without germ pore, dextrinoid. Basidia 32-36.8 X 7.2-9.6 μm, tetraspored, sterigmata 3.2-5.6 μm long., clavate, with central constriction, hyaline. Pleurocystidia

20-29.6 X 6-9.6 μm, apex 4-5.6 μm diam., flask-shaped, with long or short neck, subcapitate or non capitate, some with a wall thickening in the apex, hyaline or with grayish yellow content, very rare. Cheilocystidia 19.2-28.8 X 5.6-7.2 μm, apex 2.8-4 μm diam., flask-shaped or cylindric-ventricose, with long or short neck, capitate or non capitate, many with a wall thickening in the apex, hyaline, rare. Lamellae edge heteromorphous and fertil. Hymenophoral trama subparallel. Pileus trama radial, hyphae 4.4-18.4 μm diam., thin to thick (1.6 μm) wall, hyaline, yellowish or orange yellowish. Cuticle very thin, hyphae (3.2-)4.8-11.2 μm diam., postrate, coarsely incrusted wall with a yellowish, yellowish brown or orange brown pigment. Pileocystidia 30.4-48 X 5.2-8.8 μm, cylindric, apex rounded or attenuate, sometimes with the medium part inflated, subthick wall, with grayish yellow content, some with scanty yellowish or yellowish brown pigment incrusted, especially to the base. Caulocystidia 29.6-56.8 X 4.4-8.4 μm, apex 4.4-10.4 μm diam. in sub- and capitate, cylindric to cylindric-clavate, some ventricose with apex rounded or inflated, rare cylindric-capitate or subcapitate, with subthick wall (0.5-0.8 μm), with yellowish or orange brown vacuolar pigment, some with a yellowish brown pigment incrusted in its walls, forming a palisade in stipe apex, very abundant. Clamp connections present. A yellowish pigment is dissolved when mounted in KOH.

HABITAT. Gregarious on a decayed stipe palm, in a caducifolius tropical forest.

EXAMINED SPECIMEN. NAYARIT, Mpio. of Las Varas, Chacala-Chacalilla road, Nov. 21, 1986, **Vargas 19** (IBUG, holotype; XAL, isotype).

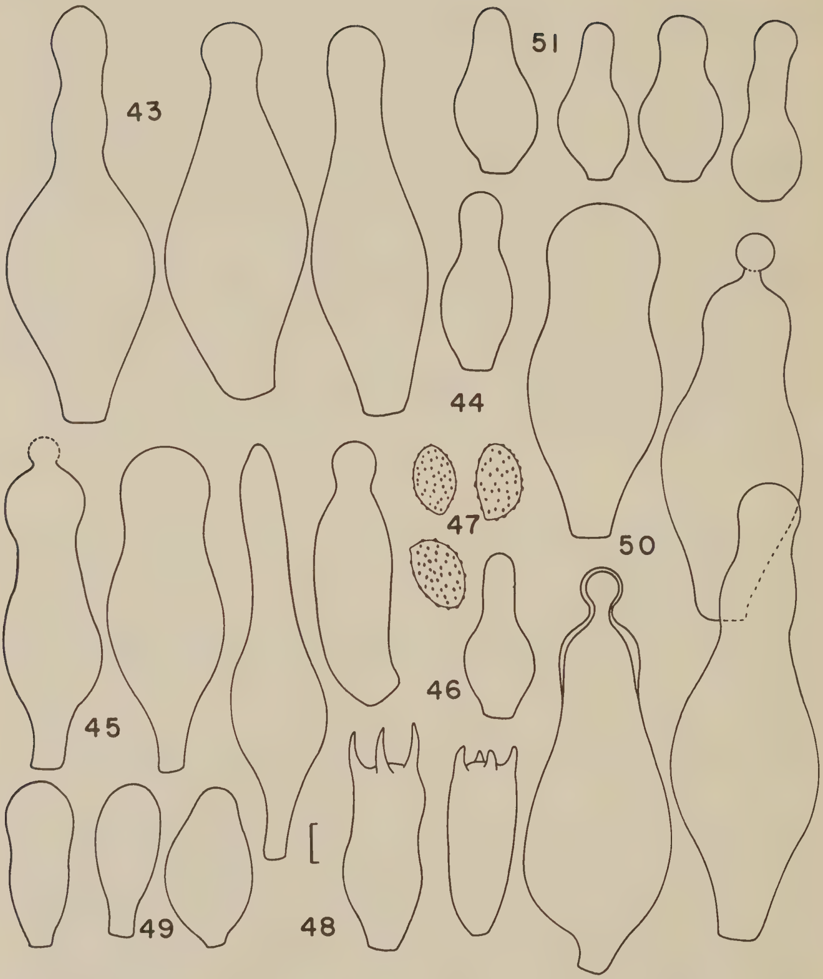
OBSERVATIONS. *G. robustus* is characterized by its big and robust basidioma, evanescens veil that leaves fibrillose remnants on the stipe, tropical habitat, big and subglobose to widely ellipsoid spores with perisporium, presence of pleuro-, cheilo-, pileo- and caulocystidia and by the radial pileus trama. For its basidioma size it is close to *G. magnus*, *G. spectabilis*, *G. rugulosus* Valenzuela, Guzmán & Castillo, *G. magnificus and G. subspectabilis* Hesler. *G. magnus* has smaller spores, of 7.5-10 X 5.5-7 μm, pleuro-, pileo- and caulocystidia are absent and pileus trama is interwoven (Hesler, 1969). *G. spectabilis* also has smaller spores, of 8-10 X 4.5-5.5 μm, pileus trama interwoven and lacks pileocystidia (Hesler, **op. cit.**). From *G. rugulosus* is distinguished by the membranous annulus, spores of (7.6-)8.4-10.4(-11.2) X 6.4-8(-(.6) μm, with conspicuous big warts, pileus trama interwoven and pileocystidia absent (Valenzuela **et al.**, 1981). *G. magnificus* has smaller spores, of 7.6-9.2 X 5.6-6.4 μm and pileo- and caulocystidia absent (Guzmán-Dávalos & Guzmán, 1986). The only species considered by Hesler (**op. cit.**) with big spores is *G. subspectabilis*, of 9-13 X 6-7.5 μm, but they are fusiform to sublimoniform, furthermore this species has a pileus with appresed fibrillose squamules, a submembranous veil and pileocystidia absent.

Gymnopilus tuxtlense Guzmán-Dávalos, **sp. nov.**
Figs. 30, 32-51

Pileus 10-25 mm diametro, convexus ad planus, mammiformis ad umbilicatus, glabrus ad velutinus, hygrophanus, brunneo-aurantiacus vel aurantiaco-ferrugineus ad flavido exsiccatio. Lamellae adnatae ad sinuatae, subconfertae, latae, brunneo-ferruginae. Stipes 15-30 X 1-2 mm, centralis, fibrillose byssoideus, pileo concoloro, basis lanuginosus. Contextum flavidus. Sporae (6.8-)7.2-9.2(-10.4) X 4.4-5.6(-6) μm, ellipsoidae, verrucosae, dextrinoidae. Pleurocystidia hyalina de duo typus, a) 12-21.6 X 4-7.2(-8) μm, cylindrico-ventricosa vel ampullacea, non capitata vel subcapitata, perrara et incospicua et b) 26.4-56 X 8-16.8 μm, ventricoso-rostrata, clavata, ampullacea, non capitata vel subcapitata, infrequens autem conspicua. Cheilocystidia 14.4-23.2 X (6.4-)7.2-12 μm, ventricoso-rostrata, spatulus-rostrata vel ampullacea, subcapitata vel capitata, hyalina vel lutea. Trama pileus radiata. Pileocystidia et caulocystidia nulla. Fibuligerus. Lignicola ad tropicalis sylva, Veracruz, prope Estación Biológica de Los Tuxtlas, UNAM. Holotypus Guzmán 19671 (XAL).

Pileus 10-25 mm diam., convex to plane, sub- or mammiform to umbilicate, glabrous to velutinous, or cottony-fibrillose under lens, half or more than half striate by transparence, almost to the disk, hygrophanous, orange brown or rusty orange, to mustard yellow with orange tinges when dry. Lamellae adnate to sinuate, subclose, broad, rusty brown. Stipe 15-30 X 1-2 mm, equal to lightly inflated to the base or subbulbous, central, glabrous, cottony-fibrillose under lens, pruinose-fibrillose to the apex, concolor with the pileus, fibrilles whitish, hollow. Stipe base with a mycelium halo or a lanose zone, whitish to mustard yellow when dry (probably orange yellow when fresh). Veil not seen. Context very thin, yellowish. Spore print ochraceous brown with light tinges orange yellow. KOH stains pileus dark reddish orange brown.

Spores (6.8-)7.2-9.2(-10.4) X 4.4-5.6(-6) μm, ellipsoid to amygdaliform, with subthick wall, verrucose, without germ pore, yellowish brown, dextrinoid (yellowish with light reddish tinges or brown with reddish orange tinges in Melzer's reagent). Basidia (13.6-)16-27.2(-28) X (4.4-)5.6-7.6(-8.8) μm, tetraspored, rare bispored, sterigmata 1.6-4.8 μm long., short clavate, with or without central constriction, hyaline or with yellowish, yellowish brown or orange brown content. Basidioles 16-20.8 X 6.8-9.2 μm, spathulate, clavate inflated, spathulate-rostrate, rare or abundant in tufts, in lamellae edge and faces, hyaline. Pleurocystidia of two types: a) 12-21.6 X 4-7.2(-8) μm, apex 3.2-5.2 μm, cylindric-ventricose, or flask-shaped, sub- or non capitate, hyaline, very rare and inconspicuous, and b) 26.4-56 X 8-16.8 μm, apex (3.2-)4.4-8(-9.2) μm diam., ventricose-rostrate, clavate, flask-shaped, capitate, subcapitate or non capitate, with long or short neck, occasionally with a moniliform neck, sometimes with an excrescence in the apex, with thin to subthick wall, especially in the apex, hyaline, rare but conspicuous. Cheilocystidia 14.4-23.2 X (6.4)7.2-12 μm, apex 2.8-5.6 μm diam., ventricose-rostrate, spathulate-rostrate, or flask-shaped sub- or capitate, hyaline or with yellowish content, some with the apex brown with orange tinges. Lamellae edge heteromorphous. Hymenophoral trama subparallel. Pileus trama radial, very thin,



Figs. 43-51: *Gymnopilus tuxtlense*, 43: pleurocystidia, type b (Guzmán 19812), 44: pleurocystidium, type a, 45: pleurocystidia, type b, 46: cheilocystidium (all from Guzmán 19798), 47: spores, 48: basidia, 49: basidioles (all from Pérez-Silva 95, MEXU-19425), 50: pleurocystidia, type b, 51: cheilocystidia (both from Pérez-Silva 95, MEXU-19425)(bar = 4 μm).

hyphae with subthick to thick wall. Cuticle with hyphae (2.4-)3.2-13.6 μm diam., postrate, few hyaline, many yellowish, some yellowish brown or orange brown, with or without incrusted pigment. Pileocystidia and caulocystidia absent. Clamp connections present. Lactiferous hyphae present. No pigment is dissolved in KOH.

HABITAT. Gregarious on branchs or rotten trunks, in a perennifolius tropical forest and in a coffee plantation.

EXAMINED SPECIMEN. VERACRUZ, Catemaco to Montepío road, Estación Biológica de Los Tuxtlas, UNAM, reserve zone, Jul. 26, 1981, **Guzmán 19671** (XAL, holotype; IBUG, isotype); Botanical Garden zone, Jul. 26, 1981, **Guzmán 19798, 19812** and **19830** (all in XAL); Catemaco region, near to Embotelladora de Coyame, Nov. 2, 1982, **Pérez-Silva 95** (MEXU-19425).

OBSERVATIONS. *G. tuxtlense* is characterized by the basidioma size, its color when dry, its tropical habitat and the presence of two types of pleurocystidia. Last characteristic is only present in *G. subbellulus* Hesler, sensu Hesler (1969); however the type of this species (Smith 49838, MICH) has only one type of pleurocystidia (23-25 X 4-6 μm, ventricose). On the other hand, *G. hemipenetrans* has three types of pleurocystidia (see under this species). Macroscopically, both *G. subbellulus* and *G. tuxtlense are close*, both have small basidiomata and mustard yellow tinges when dry, but Hesler's species grows in coniferous forest, has spores 4.5-6.5 X 3.5-4.5 μm and presents pileo- and caulocystidia. Other related species is *G. radicicola* Sing., separated by a shorter stipe, smaller spores [6.5-7(-8.5) X 4.5-4.7 μm], verruculose to asperulate and pleurocystidia absent (Singer, 1975).

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DISCOSIA EUCALYPTICOLA ANAM.-SP. NOV.

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Ontario, Canada. N2L 3G1.

Discosia eucalypticola **anam.-sp. nov.** Fig. 1

Foliicola. Conidiomata pycnidioidea, hypophylla vel subinde amphigena, dissita, profunde immersa sed insuper substrato solummodo area dehiscenti ovale vel circulare procurrenti, origine intra-epidermalia vel subepidermalia, lageniformia, ventere ovale, globoso vel depresse globoso, 80-250 µm lat., 60-260 µm alt, et collo late obconico 30-70 µm lat., 40-60 µm alt., unilocularia, glabra, ut videtur ostiolata, sed per rimam linearem in telam centralem collarulorum dehiscentia; tela parietali 10-20 µm cr., ex textura angulari, in stratis extimis e cellulis crassitunicatis et atrobrunneis, in aream dehiscentiarum fere nigris, in stratis interioribus pallide brunneis vel subhyalinis et tenuitunicatis compositus. Conidiophora circum cavitatem venterem exorientia, cellulae conidiogenae redacta, in muco involuta. Cellulae conidiogenae lageniformes, rectae vel leniter curvae, hyalinae, tenuitunicatae, laeviae, 4.5-8 X 2-3 [$\bar{x}$ = 6.5 X 2.4] µm, usque ad binae annulatim prolificantes. Conidia fusiformia vel naviculata, 3-septata, hyalina vel subhyalina, laevia, sine constrictione ad septa, 20-34 X 2.5-3 [$\bar{x}$ = 27 X 2.7] µm; cellula basalis obconica, basi truncata, 3-4 [$\bar{x}$ = 3.5] µm

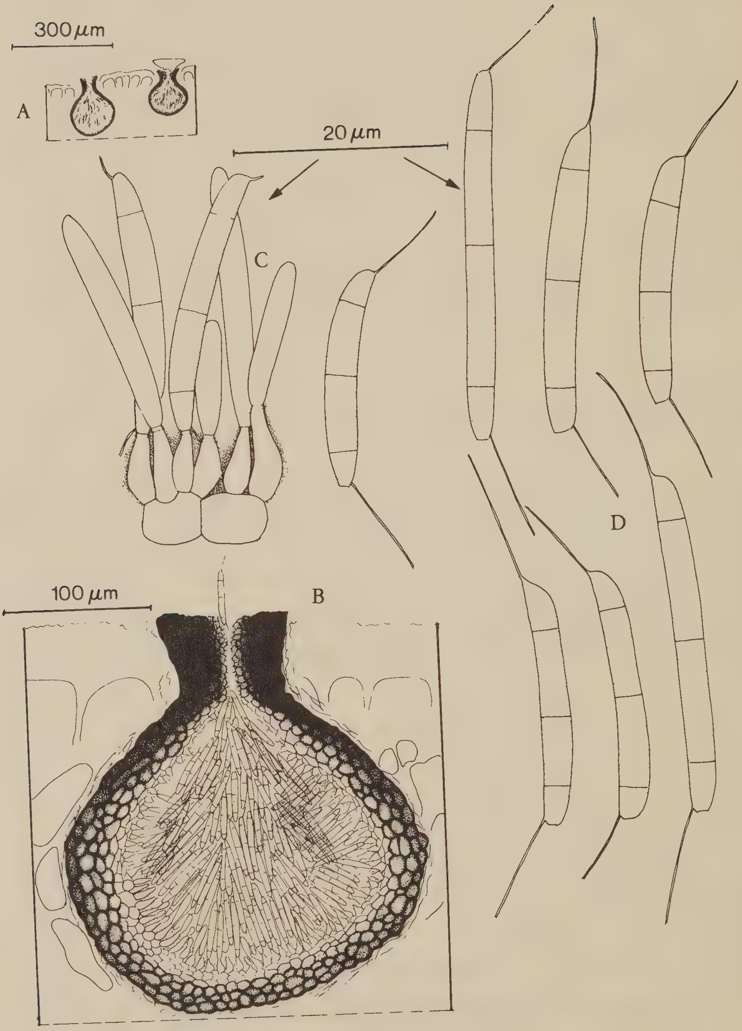

Figure. 1. *Discosia eucalypticola* ex type in DAOM 216243. A. Sectional view of a host leaf showing the immersed conidiomata. B. v.s. of a conidioma. C. Conidiogenous cells with developing conidia. D. Mature conidia.

long.; cellulae medianae duae, subcylindraceae, simul 15-26 [x̄ = 20] µm long. (a basi cellula secunda (7-)8-12(-15) [x̄ = 10] µm long., tertia 8-11(-12) [x̄ = 9.7] µm long.); cellula apicalis conica, apice rotundato, (3-)3.5-4 [x̄ = 3.7] µm long.; appendices filiformes, flexuosae, nonramosae; appendix apicalis singularis, polaris, 9-11 [x̄ = 10] µm long.; appendix basalis singularis, subpolaris, excentrica, leniter insuper basi conidiali insertis, 7-10 [x̄ = 8.5] µm long.; ratione conidii long./lat. = 9.8:1.

Foliicolous. Conidiomata pycnidioid, hypophyllous to occasionally amphigenous, scattered, deeply immersed with only the oval or circular area of dehiscence visible in surface view, intra-epidermal to subepidermal in origin, flask-shaped with an oval, globose or depressed globose venter 80-250 µm wide, 60-260 µm high, and a broadly obconical neck 30-70 µm wide, 40-60 µm high, unilocular, glabrous, seemingly ostiolate, but dehiscing by a linear split in the central neck tissue; parietal tissue 10-20 µm thick, of textura angularis, cells thick-walled and dark brown in the outer layers, almost black in the area of dehiscence, paler in the inner layers. Conidiophores arising all around the cavity of the venter, reduced to conidiogenous cells, colourless, smooth, invested in mucus. Conidiogenous cells lageniform, straight or somewhat bent, colourless, thin-walled, smooth, 4.5-8 X 2-3 [x̄ = 6.5 X 2.4] µm, with 1 or 2 annellations. Conidia fusiform to naviculate, 3-septate, colourless to almost colourless, wall smooth and without constrictions at the septa, 20-34 X 2.5-3 [x̄ = 27 X 2.7] µm; basal cell obconic with a truncate base, 3-4 [x̄ = 3.5] µm long; 2 median cells subcylindrical, together 15-26 [x̄ = 20] µm long (second cell from the base (7-)8-12(-15) [x̄ = 10] µm long, third cell 8-11 (-12) [x̄ = 9.7] µm long); apical cell conical with a rounded apex, (3-)3.5-4 [x̄ = 3.7] µm long; appendages filiform, flexuous, unbranched; apical appendage single, polar, 9-11 [x̄ = 10] µm long; basal appendage single, excentric, inserted slightly above the conidium base, 7-10 [$\bar{x} = 8.5$] µm long; mean conidium length/width ratio = 9.8:1.

Habitat: On leaves of *Eucalyptus calophylla* and *Eucalyptus* sp.

Specimens examined: 1. DAOM 216243 [Holotype], on leaves of *Eucalyptus* sp., King's Park, Perth, West Australia, 25.IX.1992, B.Kendrick; 2. DAOM 216244, on leaves of *Eucalyptus calophylla*, John Forrest National Park, West Australia, 4.X.1992, B.Kendrick.

Known distribution: Australia.

Sutton (1980) published a revised generic description of *Discosia* incorporating modern anatomico-ontogenic criteria. The following characters were considered to be diagnostic: (1) eustromatic, flattened, black, unilocular to multilocular conidiomata with 1-many, circular, papillate ostioles; (2) conical colourless to pale brown conidiogenous cells, and (3) holoblastic, dorsiventral, straight or slightly curved, 3-4-euseptate, colourless to pale brown conidia, with (4) two unbranched, filiform, polar or subpolar appendages one on each of the end cells on the concave side of the conidia. Subramanian & Reddy (1974), however, recognized the conidiogenous cells as annellidic, reported the existence of septate, branched conidiophores in a few species and stressed the importance of conidium morphology as well as the relative lengths of conidial cells in differentiating species. Vanev (1991, 1992a,b, 1993) followed these approaches when he discussed the species concepts and described three new species in the genus, although he did not provide details of conidium ontogeny. Nag Raj (1993) broadened the generic concept to include superficial and applanate to semi-immersed or immersed and indeterminate or pycnidioid conidiomata, and conidium appendages that are branched in at least one species.

Species with indeterminate to pycnidioid conidiomata include *Discosia ceanothi* (Ramaley) Nag Raj, *D. eucalypti* (Patouillard) Nag Raj, *D. lauricola* Nag Raj, *D. novaezelandiae* Nag Raj and *D. pyri* Koshkelova and form a group to which *D. eucalypticola* belongs. *Discosia eucalypticola* differs from the others in possessing conidiomata with a well differentiated globose venter and obconical neck tissue. In conidium morphology it is close to *D. eucalypti*, but differs from it in the size of the conidia and the relative lengths of the individual conidial cells and in the morphology of its conidiomata. Unlike *D. eucalypti* it has reduced conidiophores. The immersed conidiomata with only the top of the neck tissue visible in surface view, and the almost black wall tissues of the conidiomata in the venter and neck, strongly suggest that the fungus is well adapted for life in a harsh environment. *D. eucalypticola* appears to be a link in an evolutionary trend from superficial applanate conidiomata to immersed, indeterminate to pycnidioid conidiomata.

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TRICHOLOSPORUM IN MEXICO AND DESCRIPTION OF A NEW SPECIES

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ABSTRACT

Tricholosporum tropicalis Guzmán, Bandala & Montoya is described as a new species from a tropical plantation in the State of Chiapas, and ***T. pseudosordidum*** Sing. is recorded for the first time from Mexico (State of Veracruz); it was previously known only from Florida (U.S.A.). A key to the four species of ***Tricholosporum*** known from Mexico is presented. Observations on the type of ***T. porphyrophyllum*** (Imai) Guzmán ex Baroni from Japan are also made, in order differentiate this species from ***T. subporphyrophyllum*** Guzmán.

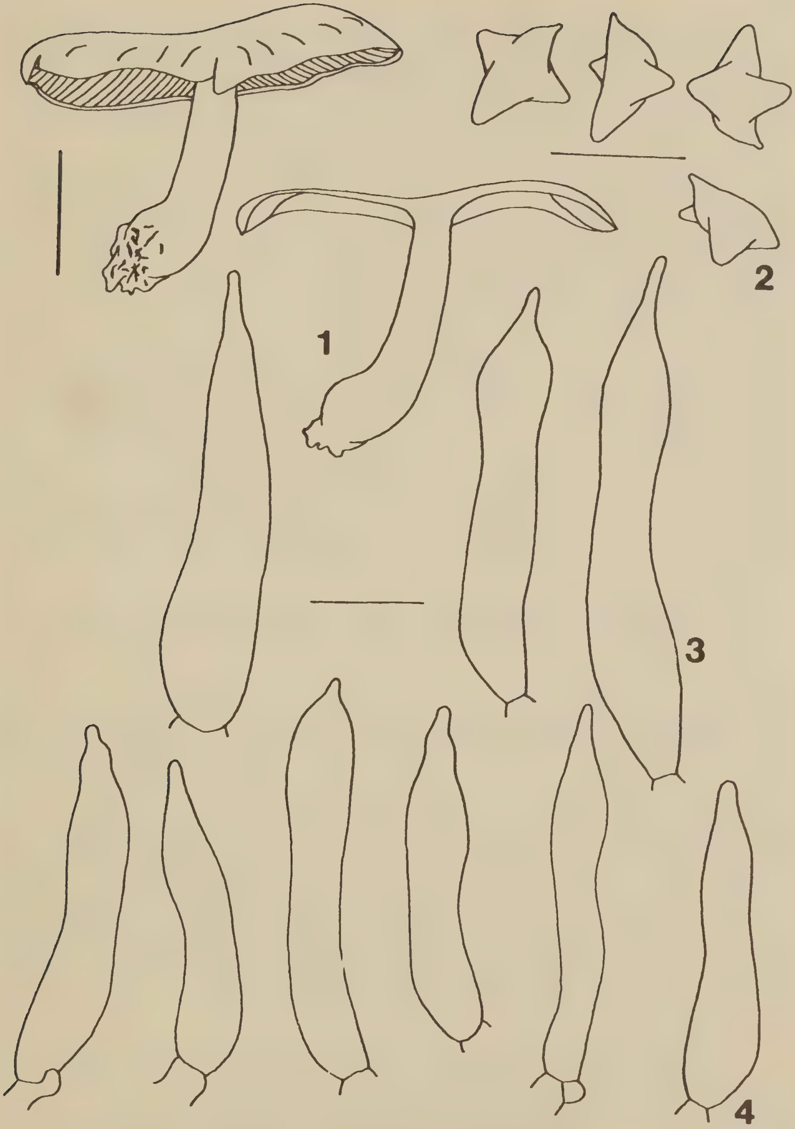
INTRODUCTION

Tricholosporum Guzmán (1975) has been discussed by Baroni (1982), Mora and Guzmán (1983), Guzmán *et al.* (1990) and Bon (1984, 1991). The type species ***T. goniospermum*** (Bres.) Guzmán ex Baroni was considered by Singer (1986) in Section Iorigida of ***Tricholoma***, while Bon (*op. cit.*) place it in ***Tricholoma*** subgenus ***Tricholosporum*** (Guzmán) Bon. Seven species of the genus are known to occur in the world (Europe, North of Africa, Japan, U.S.A. and Mexico), but only two species, ***T. subporphyrophyllum*** Guzmán and ***T. longicystidiosum*** Guzmán, Montoya & Bandala are known in Mexico. In this paper two more species are recorded from this country, one of which is a new species. Annotations of color are based in Kornerup and Wanscher (1978).

Tricholosporum tropicalis Guzmán, Bandala et Montoya, sp. nov.
Figs. 1-4

Pileus circa 58 mm latus, subconvexus vel plano-convexus vel exigue concavus, glaber, siccus, violaceo-subcaeruleus ad violaceo-griseolus, vel brunneo-vinaceous vel brunneolus in succus. Lamellae adnatae, brunneo-incarnatae vel rufobrunneo, vel brunneo-violaceus, acie concolori. Stipes circa 35 x 8 mm, subbulbosus, glaber, albidus ad griseo-albidus vel pileo concolor. Caro albida, odore et sapore grato. Sporae (4-) 4.8-5.6 x 3.2-4 (-4.4) μm, cruciformes, hyalinae, inamyloideae. Pleurocystidia 30.4-40 (-44) x 5.6-7.2 μm, hyalina, tenuitunicata, subcylindracea vel subventricosa, rostrato-mucronata. Cheilocystidia (20-) 24-37.6 (-40) x 5.6-7.2 μm, hyalina, tenuitunicata, pleurocystidiis similia. Cutis gelificata. Trama subregularis. Fibulae frequentes. Ad terram, solitarius, theobromis cultis. Regio tropicalis. Mexico, Chiapas, prope Tapachula, A. Jadra s.n. (holotypus XAL).

Pileus approx. 58 mm in diameter, subconvex to convex-applanate or slightly concave, smooth, dry, somewhat sulcate in dry condition, bluish violet (18 B5) to grayish violet (18 B4) when fresh to vinaceous-brown (8D4) to brownish (7D5) in dry, with some bluish-violet (18D3) tinges. Lamellae adnate, ± close, pinkish-brown (8B2) to violaceous-brown (18E5), edges concolorous. Stipe approx. 35 x 8 mm, central, subbulbous, smooth, white when fresh to gray whitish (6B2 - 6C2) to concolorous with the pileus in dry condition, with irregular violaceous tinges, base covered with white mycelium. Context whitish. Odor and taste pleasant. Spores (4-) 4.8-5.6 x 3.2-4 (-4.4) μm, cruciform, hilar appendix conspicuous, thin-walled, hyaline, inamyloid. Basidia 24-30.4(-32) x 4.8-5.6 μm, claviform, clamped at the base, hyaline. Pleurocystidia 30.4-40 (-44) x 5.6-7.2 μm, abundant, hyaline, thin-walled, subventricose rostrate and mucronate, sometimes the mucron as a short cylindrical appendix. Cheilocystidia (20-) 24-37.6 (-40) x 5.6-7.2 μm, abundant, hyaline, thin-walled, similar to the pleurocystidia in form; both pleuro and cheilocystidia are projected above hymenial level. Epicutis as a thin gelatinized layer, hyphae radially arranged, 2.4-6.4 (-8)



Figs. 1-4.- ***Tricholosporum tropicalis***, 1: basidiocarp; 2: spores; 3: pleurocystidia; 4: cheilocystidia (type) (scale bar: 1=2 cm; 2=6 μm; 3-4=10 μm) (note: two of the three pleurocystidia drawing are a little wider than the cheilocystidia, however, the range of width in both is the same).

μm in diameter, thin-walled and smooth. Hymenial trama subregular, hyphae up to 20 μm in diameter, hyaline and thin-walled. Oleiferoushyphae yellowish or pale yellowish-brown, occasionally in context and hymenophoral trama. Clamp connections common.

Habitat and studied material. Solitary in soil among branches, growing in a cacao plantation, in a tropical rain forest region. Mexico, State of Chiapas, region of Tapachula, Tuxtla Chico, Experimental Station of Rosario-Iztapa, alt. 50 m, Sept. 25, 1992, A. Jadra s.n. (holotype, XAL; isotypes ENCB and BR).

Discussion. This tropical fungus is related to the species with small spores in the genus, such as ***T. pseudosordidum*** (Sing.) Baroni and ***T. atroviolaceum*** (Murr.) Baroni, both from subtropical regions. The abundant pleurocystidia and cheilocystidia and rather robust basidioma are the major differences between them. ***Tricholosporum atroviolaceum*** lacks pleurocystidia and cheilocystidia (Baroni, 1982) and ***T. pseudosordidum*** (see below) has inconspicuous pleurocystidia.

Tricholosporum pseudosordidum (Sing.) Baroni in Mexico

Figs. 6-12

This species was described by Singer (1945) as ***Tricholoma***, from Florida, U.S.A. and discussed later by Baroni (1982) as ***Tricholosporum pseudosordidum***. The type of this species, as pointed out by Baroni is lost. Singer indicated that it was retained in Farlow Herbarium, but the present authors did not find it, neither there nor at the Herbarium of Miguel Lillo Institute and University of Florida Herbarium, as indicated by the respective curators. According to Singer's original description, the species apparently lacks pleurocystidia "cystidia none seen; cheilocystidia (mucronate) and pseudoparaphyses (basidiomorphus) scattered at the edge of the lamellae, the size of the basidia, very inconspicuous".

In the Gulf area of Mexico (central Veracruz) two specimens were found, which represent ***T. pseudosordidum***. They have pileus up to 30 mm in diam., plano-convex with a central umbo, pale violaceous (18A3 - 18B4) or yellowish to pale orange (4A3 - 5A4) in the disc and with violaceous (18A3) or lilaceous (17B2) tinges toward the margin, hygrophanous. Lamellae adnate, lilaceous or brown-violaceous (18A3 - 18E5). Stipe up to 40 x 4 mm, ± attenuated towards the base, whitish to white-vinaceous. The spores are 4.8-5.6 x (3.2-) 4-4.8 (-5.6) µm. Pleurocystidia are very scarce and inconspicuous, (15.2-) 17.6-28 x (3.2-) 4-5.6 µm, hyaline, subcylindric, subfusiform or subventricose, mucronate or with a short neck. Cheilocystidia 18.4-26.4(-28) x (3.2-) 4-5.6(-6.4) µm, ± numerous, but sometimes inconspicuous, similar in form to pleurocystidia. The basidia are similar in size to both type of cystidia, (16-) 20-24 (-25.6) x 4.8-5.6 µm, tetrasporic, hyaline to yellowish, clavate or subcylindric. Epicutis a thin gelatinized layer with repent hyphae 2.4-5.6 µm wide, thin walled. Hymenial trama regular, with hyphae 1.6-4.8 µm wide, hyaline to yellowish and thin walled, oleiferous hyphae occasionally observed. Clamp connections common. Singer (1945) described spores (3.7-) 4-5 (-5.5) µm, basidia 24 x 5.3-6 µm and epicutis with irregular filiform, or swollen to clavate hyphae, which are mostly repent; he did not mention oleiferous hyphae.

The habit of this species is similar to some ***Lepista*** in the form and in the color of the basidioma. As the authors observed the most typical macroscopic feature of the genus *Tricholosporum* are the pinkish-brown to vinaceous brown or violaceous-brown tinges of the basidiomes. This can also be observed in the color plates of Bon (1984) and Riva (1988). Singer (1945) described *T. pseudosordidum* having white lamellae but this seems inaccurate, because he considered this species similar to ***Lepista sordida*** (Fr.) Sing., which presents pinkish lamellae as most of the species in the genus (Kühner and Romagnesi, 1953; Bigelow, 1982, Bon, 1984).

Habitat and studied material. Solitary in subtropical forests with *Quercus* and *Liquidambar*. Mexico, State of Veracruz, I Mushroom Exposition of Cordoba (specimen collected by Bustos in the road Cordoba to Huatusco), Aug. 26, 1989, Bandala 2171 (XAL). Road Xalapa to Huatusco, 1 km from the deviation to Jalcomulco, Jul. 2, 1983, Chacón 1246 (XAL).

Observations on *T. porphyrophyllum* and *T. subporphyrophyllum*

Guzmán (1975) based on *Tricholoma porphyrophyllum* Imai (in Ito, 1959), described *Tricholosporum subporphyrophyllum* Guzmán by the presence of pleurocystidia. Guzmán and latter Baroni (1982) considered Imai's species as *Tricholosporum*. However, neither Ito (1959) nor Hongo (1988) indicate either the presence or absence of hymenial cystidia in their descriptions of *T. subporphyrophyllum* (as

Tricholoma). A revision on the type of *T. porphyrophyllum* (Imai) Guzmán ex Baroni (Imai, Jul. 31, 1937, SAPA), showed the absence of pleurocystidia and cheilocystidia. The type presents spores 5.6-6.4 (-7.2) x (3.2) 4-4.8 (-5.6) µm (fig. 5); basidia (18.4-) 20-21.6 x 4-4.8 (-5.6) µm, tetraspored, hyaline, with cyanophilous or carminophilous bodies lacking; hymenial cystidia absent; context with cylindric or inflated hyphae up to 12 µm diam., hyaline to yellowish; lamellar trama of parallel hyphae, 3.2-4.8 µm in diam., frequently with oleiferous hyphae (yellowish-brown to light amber), and epicutis as a thin gelatinized layer of ± interwoven cylindric hyphae, 1.6-3.2 µm wide. This is the first time that the type of Imai's species is studied since its description.

KEY TO THE SPECIES OF *TRICHOLOSPORUM* KNOWN TO OCCUR IN MEXICO

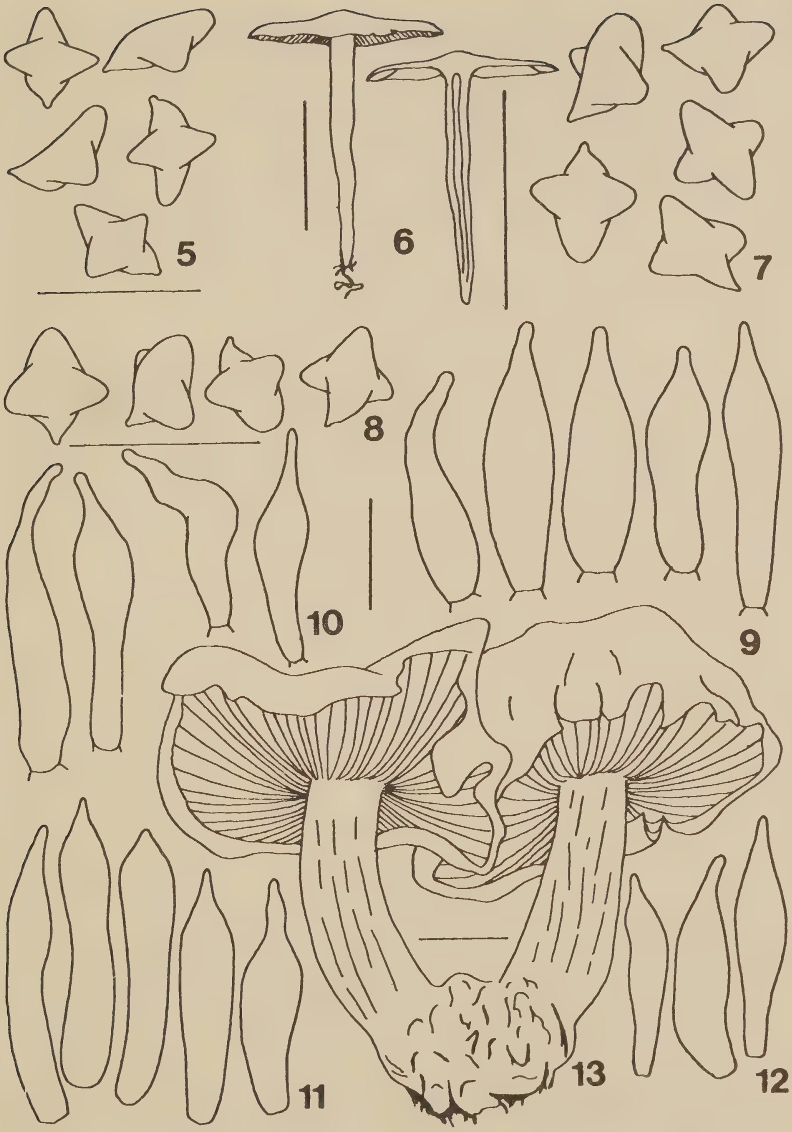
1a. Species with small spores, 4-5.6 µm long 2

1b. Species with large spores, 5-8 µm long 3

2a. Pleurocystidia scarce and inconspicuous, 17.6-28 µm long. Cheilocystidia ± inconspicuous, 18.4-26.4 µm long. Subtropical species (known only from the central part of the State of Veracruz). . . . . *T. pseudosordidum*

2b. Pleurocystidia abundant, 30.4-40 µm long., projecting above hymenial level, Cheilocystidia abundant, 24-37.6 µm long. Tropical species (known only from the State of Chiapas) . . . . *T. tropicalis*

3a. Medium size basiomata, pileus 20-60 mm wide; stipe 30-50 x 6-9 mm. Pleurocystidia 19-37 µm long. Cheilocystidia 17-37 µm long. Tropical species (known only from the States of Morelos and Oaxaca) . . . . *T. subporphyrophyllum*



Figs. 5-13.- 5: *Tricholosporum porphyrophyllum*, spores (type). 6-12: *T. pseudosordidum*, 6: basidiomata; 7-8: spores; 9-10: pleurocystidia, 11-12: cheilocystidia (6, 7, 9, 11: Bandala 2171; 8, 10, 12: Chacón 1246). 13: ***T. longicystidiosum***, basidiomata (type) (scale bar = 10 μm, except in 6 & 13 = 20 mm).

3b. Large size basidiomata, pileus 70-160 mm wide; stipe 80-130 x 30-50 mm. Pleurocystidia 30-65 μm long. Cheilocystidia 26.6-48.4 μm long. Subtropical species (known only from the NE of the State of Morelos) . . . . ***T. longicystidiosum*** (Fig. 13)

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STUDIES IN THE GENUS *PLEUROTUS*, III. THE VARIETIES OF *P. OSTREATUS*-COMPLEX BASED IN INTERBREEDING STRAINS AND IN THE STUDY OF BASIDIOMATA OBTAINED IN CULTURE

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SUMMARY

The *Pleurotus ostreatus*-complex ascribed to *P. ostreatus* (Jacq. : Fr.) Kumm. var. *ostreatus*, *P. ostreatus* var. *columbinus* (Quél.) Quél., and *P. pulmonarius* (Quél.) Sing. was studied, on basis of the basidiomata obtained on barley straw in a mushroom farm. The strains of *P. ostreatus* var. *ostreatus* and *P. ostreatus* var. *columbinus* are incompatible, and it is concluded that they are independent species. A discussion on *P. pulmonarius* (= *P. ostreatus* var. *florida* Eger) and the misidentifications of *P. sajorcaju* (Fr.) Sing. are presented. Also a key to the considered species is included. All these fungi are unknown in their wild form in Mexico.

INTRODUCTION

Continuing the researches on *Pleurotus* (Fr.) Kummer by the authors (Guzmán *et al.*, 1991, 1993b), as well as those by the senior author (Guzmán *et al.*, 1980), the interbreeding strains of *P. ostreatus* (Jacq. : Fr.) Kumm. complex is discussed, as well as the study of the basidiomata from strains obtained in culture. The main objective of the present series, is to define taxonomically and genetically the common and commercial strains used in Mexico.

MATERIALS AND METHODS

Fourteen strains of *Pleurotus ostreatus*-complex from different countries were studied (Table 1). All of them are preserved on malt-agar in the Fungus Strain Collection at Instituto de Ecología. Concerning with the origin of the strains, IE-4, 8, 9, 49 and 70 come from INIREB (Mexico); IE-115 and 140 from Fungi Perfecti at U.S.A.; IE-126 from Michigan Technological University at Houghton, U.S.A.; IE-129 and 131 from Institute for Fermentation at Osaka, Japan; IE-135, 136 and 137 from Czechoeslovaquia through ICIDCA at Cuba, and IE-138 from CINVESTAV at Mexico City.

Cultivation of basidiomata at the mushroom farm followed Guzmán *et al.* (1993a). Basidiomata were obtained at a mushroom farm on barley straw as substratum. Dilutions of spore prints of strains IE-8, 9, 126, 136 and 140 on distilled water were prepared, in order to produce monosporic cultures, to which 0.5 ml of this dilution was inoculated on malt-agar in Petri dishes. About 25 monosporic cultures of each strain were isolated and 12 of them were selected at random, for determining mating types. Monosporic cultures of each strain were interbreed, avoiding reciprocal pairings. Positive pairings were considered when clamps at joint and at periphery of mycelia were developed, and on the other hand, negative pairings were considered when clamps were absent. Monosporic cultures were classified in four types of incompatibility, according to Eger (1978). Basidiomata were grown under indirect natural illumination and direct natural illumination, inside and outside the mushroom farm, in order to observe their color variations. The microscopic observations were made on slides mounted in 5 % KOH, in cotton blue in lactophenol, Melzer solution and Congo red. Color in the descriptions are according to Kornerup and Wanscher (1978). All the basidiomata studied are deposited at XAL Herbarium.

RESULTS

1) Strains interbreeding

Strains selected according to monosporic cultures, presented a tetrapolar heterotallic sexual pattern and its respective monosporic cultures were classified in 4 incompatibility classes, as shown in table 2. Strains were separated in two groups according to its interbreedin potential, depending if it was 0 or 100 %. Table 3 shows the interbreedings, and it can be noted that the strains IE-8 and 126, 9 and 136, 9 and 140, and 136 and 140 were compatible while the rest were incompatible. In consequence, it can be concluded that *P. ostreatus* var. *ostreatus* is independent of *P. ostreatus* var. *columbinus*, considering the incompatibility.

Table 1. Studied strains, its origin and identification

strain	species	origin
IE-4	*P. pulmonarius*	Europe (as *P. ostreatus* var. *florida*)
IE-8	*P. ostreatus*	Europe ?
IE-9	*P. columbinus*	Europe (as *P. ostreatus*)
IE-49	*P. ostreatus*	Europe (as *P. sajorcaju*)
IE-70	*P. columbinus*	Europe (as *P. ostreatus*)
IE-115	*P. pulmonarius*	U.S.A. (as *P. ostreatus* var. *florida*)
IE-126	*P. ostreatus*	U.S.A. (as *P. ostreatus*)
IE-129	*P. ostreatus*	Japan (*P. ostreatus*)
IE-131	*P. ostreatus*	Japan (*P. ostreatus*)
IE-136	*P. columbinus*	Europe (as *Pleurotus* sp.)
IE-137	*P. columbinus*	Europe (as *Pleurotus* sp.)
IE-138	*P. ostreatus*	Europe (as *Pleurotus* sp.)
IE-140	*P. columbinus*	U.S.A. (as *P. ostreatus*)

2) Differences between *Pleurotus ostreatus* var. *ostreatus* and *P. ostreatus* var. *columbinus* (Figs. 1-5, 7, 9-13)

Basidiomata from the strains IE-8, 49, 126, 129, 131 and 137 agree with the concept of *P. ostreatus* var. *ostreatus*. They have pileus (25-) 50-100 (-150) mm in diam., hygrophanous, dark grayish-brown (6C2-6D3) to yellowish-brown (5B3) when dried; sometimes pale grayish-brown to yelowish-brown (5B3-5B2) or grayish-brown (5B2). Primordia grayish-brown (5B2, 5C2-6C2) to grayish-white (5A2), with buff tinges. Pileus color annotated was observed in basidiomata obtained inside the mushrooms farm. However, when developed outside the farm under natural light exposition were darker, dark grayish-brown (7D3) or dark brown (6D5) to chocolate-brown (6F6); primordia were dark grayish-brown to chocolate (6F7-6F6), dark chocolate-brown (7F6) to blackish-brown (6F4) or paler (6D5) at some areas. Lamellae ivory-white to cream color (4A2-4A3), sometimes with pale grayish-brown tinges, decurrent to subdecurrent. Stipe 10-30 x 7-18 mm or frequently absent, white to yellowish-white (2A2), excentric, smooth or subvelutinose, villous towards the base. Context whitish, odor and taste mild or agreeably fungoid. Spore print grayish-white or white with pinkish tinges (9B2) to greyish with lilac tinges (14C2), pinkish-grey (14B2), violaceous-grey or lilac (14C3), to violet with grayish tinges (16D2, 17D3-17D2). Spores (7.2) 8-10.4 (-11.2) x 3.2-4 (-4.8) μm, ellipsoid, hyaline, thin walled. Basidia 16-28 x 4-6.4 μm, claviform, hyaline, tetrasporic. Cystidioid elements 16-20.8 x 4.8-5.6 μm, rare, ventricose or subcylindric, mucronate or lecythiform, hyaline, with a mucilaginous drop at apex. Cystidia absent. Context hyphae 2.4-13.6 μm wide, thin walled, rarely thick walled up to 1.6 μm, hyaline, clamped. Hymenial trama iregular; hyphae 3.2-12 μm diam., hyaline, thin or thick walled 0.8-1.6 μm, clamped. Hyphal system monomitic.

Habit pleurotoid, cespitose, but under certain culture conditions strains IE-126, 129 and 131 frequently developed a clitocyboid habit.

Studied specimens: **Guzmán 30638**; **Montoya 1634-A, 2124**; **Martínez 288**; **Salmones 26, 26-A**; **Tapia 1050** (all from strain IE-8); **Salmones 30** (from strain IE-49); **Montoya 1992, 1999** (from strain IE-126); **Guzmán 30635, 30636**; **Montoya 1999-A, 2112** (from strain IE-129); **Montoya 1993, 2000** (from strain 131); **Montoya 1905-A** (from strain IE-137).

Kühner and Romagnesi (1953) considered *P. ostreatus* "brun. gris, noirâtre ou noir-bleuâtre, 5-15 cm. Sp. 8-11 x 3-4 μ". Hilber (1982) described the pileus of *P. ostreatus* variable in color, among dark grey, brownish-buff to violaceous-brown, and spores (5.6-) 9.5- 13.7 x 2.7-3.2-4.2 μm. Bresinsky *et al.* (1977) reported the pileus dark brown, grayish-brown or blackish-brown to paler in adult basidiomata. Moser (1983) considered *P. ostreatus* with pileus grey, grey-lilaceous, blackish-grey, steel-grey, grey-brown or blue-blackish, spores 7.5-11 x 3-4 μm and tramal hypha thin walled.

Basidiomata from the strains IE-9, 70, 135, 136 and 140 agree well with *P. ostreatus* var. *columbinus*, by the dark grayish-blue (22E2-22E4) to blueish-gray (23C2-23C3) with steel shades, to grayish (23C1), gray with olivaceous tinges (1B2) or grayish-white with blueish (20B2) tinges; brownish-buff (5B3) when dried at the disc or over the pileus,

Table 2. Incompatibility classes of studied strains

STRAIN	INCOMPATIBILITY TYPE	MONOSPORIC CULTURES
IE-8	I	1
	II	2, 3, 6, 7, 10, 11
	III	4, 12
	I	5, 9
IE-9	I	1, 2, 3, 5, 11
	II	8
	III	9, 6
	IV	7, 10, 12, 4
IE-126	I	3, 10
	II	5, 11
	III	6, 7
	IV	2, 4, 8, 9, 12
IE-136	I	1, 4, 11
	II	7
	III	10
	IV	2, 3, 5, 6, 8, 9, 12
IE-140	I	3, 4, 6, 11
	II	1
	III	5, 7, 8
	IV	2, 9, 10, 12

having or not blueish (23C2) tinges or pale yellowish-brown (5B3) to uniformly grayish-white (5B2), or grayish-brown (6E3) all over, smooth, sublubricous, but imbricately fibrillose below the cuticle, margin sometimes translucent striated, (20-) 50-100 (-180) mm in diam. Primordia 1-8 mm in diam., dark grayish-blue (23D4) to paler (23C1-23C3), grayish-brown (5E3-5E4, 6E2-6E3, 6D3) to cream-buff (4A3), sometimes with yellowish (4A2) zones, frequently whitish to grayish, smooth, lubricous. Lamellae yellowish-white (4A2) to grayish-white (2A3, 2B2, 2A2), sometimes grayish-green (2B2) to yellowish, sometimes dichotomic, decurrent, rarely anastamosed at the base. Stipe 15-40 x 3-30 mm, excentric, frequently well developed, yellowish-white (2A2), striated at first 1/3, subfibrillose, villose at the base. Context whitish, odor and taste fungoid agreeable. Spore print whitish or white with pinkish (9B2) tinges, grayish-white to lilaceous-gray (14B2), violaceous-gray (14B2-14C3) to violaceous (17D3-17D2, 16D2). Spores (7.2-) 8-11.2 (-12) x 3.2-4 μm, hyaline, thin walled. Basidia 16-25.6 x 4-5.6 (-6.4) μm, claviform, tetrasporic. Cystidioid elements 16-22 x 4-4.8 (-5.6) μm, rare, hyaline, claviform, ventricose or subcylindric, mucronate or lecythiform, with a mucilaginous drop at apex. Cystidia absent. Context hypha 2.4-12 (-14.4) μm in diam., hyaline, thin walled, some thick walled up to 2.4 μm, clamps numerous. Hymenial trama irregular, hypha 2.4-9.6 μm in diam., hyaline, thin walled or some thick walled up to 1.6 μm. Hyphal system monomitic.

Table 3. Interbreeding results of studied strains

	STRAIN IE-126	STRAIN IE-9	STRAIN IE-136	STRAIN IE-140
STRAIN IE-8	100 %	0 %	0 %	0 %
STRAIN IE-126		0 %	0 %	0 %
STRAIN IE-9			100 %	100 %
STRAIN IE-136				100 %

IE-8 & 126: *P. ostreatus*
IE-9, 136 & 140: *P. columbinus*

Habit pleurotoid, caespitose, frequently subclitocyboid due to the presence of a well developed central stipe. Pileus color varies by the influence of light, whitish or similar to the colors of *P. ostreatus* var. *ostreatus*; inclusively strains IE-135 and 136 developed the typical blueish tone only when grown outside the mushroom farm. It was observed also, that whitish specimens presented a paler spore print.

Studied specimens: **Montoya 2089, 2094** (from strain IE-9); **Guzmán 29737, 29738, 30404, 30405, 30406, 30407, 30408, 30411, 30412, 30462; Montoya 1966-A, 1988; Salmones 44** (from strain IE-70); **Montoya 1987, 2102, 2108, 2111** (from strain IE-135); **Guzmán 30646; Mata 466, 468; Montoya 1988-A, 1990, 2052, 2062, 2108, 2115, 2119, 2128** (from strain IE-136); **Juárez** s.n. (13-III-92) (from strain IE-140).

Kühner and Romagnesi (1953) considered the pileus color in *P. columbinus* as "gris bleuâtre ou verdâtre, avec souvent le disque incarnat ou ocracé 5-9 cm" and spores 10-12 x 3-4 μm. Hilber (1982) described the pileus blue-green, dark tawny or greenish-gray at center and ochraceous-tawny towards the base and spores 7-10.6-11 x 3.2 -3.5 μm. Bresinky *et al*. (1977) considered this fungus with the pileus pale steel-blue or ochraceous at maturity. Moser (1983) considered "Cap grey-blue, blue-greenish, disc often paler ochraceous or flesh-coloured.... Spores 10-12 x 3-4 μm". Both *P. ostreatus* var. *ostreatus* and *P. ostreatus* var. *columbinus* are very common in Europe, but unknown in Mexico.

3) *Pleurotus pulmonarius* (= *P. ostreatus* var. *florida*) vs. *P. ostreatus* (Figs. 6, 8 and 14)

Li and Eger (1979) isolated a strain of *Pleurotus* from Florida, U.S.A. which they called *Pleurotus "florida"* and later as *P. ostreatus* "var. *florida*". However, this name is contaxic with *P. pulmonarius*, according to Singer and Harris (1987) and as studied here. *P. pulmonarius* was misidentified as *P. ostreatus* according to several authors. Eger *et al*. (1979) mentioned: "the so called *P. pulmonarius* is a temperature-tolerant form of *P. ostreatus*". Many commercial strains are descendants of Li and Eger strain, as occur with that of Zadrazil deposited at INIREB (at present Instituto de Ecologia at Xalapa) in 1985 as INIREB-4 (Martínez-Carrera *et al*., 1988A), subsequently misidentified as *P. floridanus* (Stamets and Chilton, 1983; Guzmán-Dávalos *et al*., 1987) (*P. floridanus* Singer is an independent species, probably a *Hohenbuehelia*). *P. ostreatus* var. *florida* Eger is a nomen nudum (Singer, 1986; Hilber, 1982; Watling and Gregory, 1989). *P. pulmonarius* is a whitish fungus like *P. djamour* (Fr.) Boud., but this latter species differs in the dimitic hyphal system and cheilocystidia, as well as in taste and odor (Guzmán *et al*., 1993b). *P. pulmonarius* seems common at the Mediterranean zone and in Florida, U.S.A., but is unknown in Mexico.

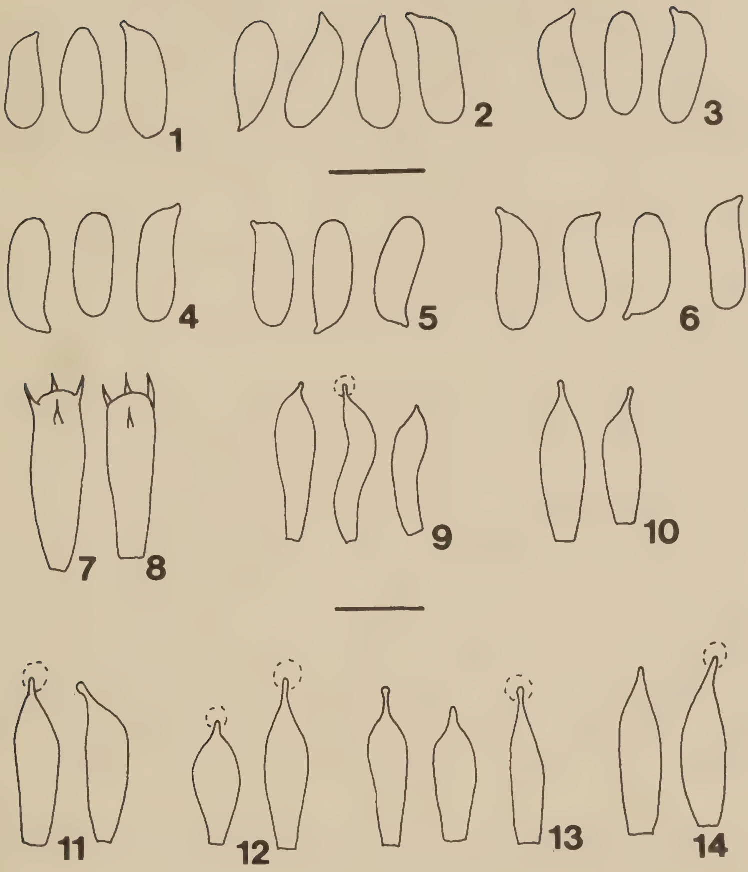
The basidiomata produced by strains IE-4, 115 and 138 agree well with *P. pulmonarius*, following the concept of Hilber (1982), Bresinsky *et al*. (1977) and Moser (1983). The pileus is characteristic in grayish-brown (5B2-5B3, 5C3-5D3) changing to ivory-white (2A2-4A2), both in primordia and mature basidiomata, or yellowish when dried, hygrophanous, smooth, imbricatelly subfibrillose bellow the cuticle, sublubricous, margin faintly striated, plano-convex to slightly central depressed, at times with a central papilla, (8-) 20-100 (-140) mm in diam. Lamellae white or whitish (pale 2A2) to ivory-white (1A2-3A2), to yellowish when dried, decurrent. Stipe (3-) 8-70 (-90) x 2-15 mm, excentric, striated at first 1/3, fibrillose and villose to hirsute at base, simple or generally ramified, base more than 30 mm in diam., ivory-white (1A2, 2A2, 3A2), hygrophanous, compact. Context whitish, odor and taste fungoid. Spore print white to grayish-white, pinkish-gray (9B2-14B2) or violaceous-gray (14C3). Spores 7.2-11 (-12) x 3.2-4 μm, ellipsoid, hyaline. Basidia 20-22.4 x 4.8-5.6 μm, claviform, tetrasporic. Cystidioid elements 20-21.6 x 4-4.8 (-5.6) μm, rare, claviform, ventricose or subcylindric, mucronate or lecythiform, hyaline, with a mucilaginous drop at apex. Cystidia absent. Context hypha 4-12 μm in diam., hyaline, thin walled, at times up to 2.4 μm thick. Hymenial trama irregular, hypha 4.8-10.4 μm in diam., hyaline, thin walled or up to 2.4 μm. Hyphal system monomitic. Hypha clamped.

Habit pleurotoid, but frequently umbelliform, caespitose, ramified from a common base. Studied material: **Guzmán 30644, 30645; Montoya 1903-C, 2012, 2122, 2123, 2125, 2126, 2127, 2130, 2131; Salmones 32** (from strain IE-4); **Guzmán 30637, 30639; Montoya 1900, 1902, 2098, 2099, 2100, 2101, 2103** (from strain IE-115); **Guzmán 30641; Montoya 1901, 2104** (from strain 138).

Specimens grown **outside the mushroom farm** developed the characteristic grayish-brown color, while those grown **inside** were ivory-white. The specimens of strain IE-138 studied (which are whitish and stipitate-ramified) have been obtained only inside the mushroom farm, and according to the thick-walled context hypha, have been considered tentatively as *P. pulmonarius*. Recently, Cailleux and Joly (1993) discussed the differences between *P. pulmonarius* and *P. ostreatus* based in cultures and field observations, and they concluded that they are two different species growing in France.

4) The misidentifications in *Pleurotus sajorcaju*

Pleurotus sajorcaju is a paleotropical species very common in Asia and Africa. Pegler (1977, 1986) considered this fungus as *Lentinus sajorcaju* (Fr.) Fr. and characterized it by the infundibuliform pileus and well developed annulus in the stipe, and dimitic hyphal system. Strain IE-49 acquired from Europe as *P. sajorcaju*, as above indicated, produces typical basidiomata of *P. ostreatus* var. *ostreatus*. At present *P. sajorcaju* is not known from American Continent.



Figs. 1-14. Microscopic features of the *Pleurotus ostreatus*-complex. 1-6: spores, 1-2: *P. ostreatus*, 3-5: *P. columbinus, 6: P. pulmonarius*. 7-8: basidia, 7: *P. ostreatus*, 8: *P. pulmonarius*. 9-14: cystidioid elements, 9-11: *P. ostreatus*, 12-13: *P. columbinus*, 14: *P. pulmonarius* (1: Martínez 288; 2 & 9: Salmones 30; 3 & 12: Montoya 2089; 4: Montoya 1987; 5: Guzmán 30406; 6: Montoya 2012; 7 & 10: Montoya 1999; 8 & 14: Montoya 1905-A; 11: Montoya 1999-A; 13: Montoya 1990). (Scale bar to spores= 10 μm; Scale bar to basidia and cystidioid elements = 12 μm).

DISCUSSION AND CONCLUSIONS

Considering the incompatibility during interbreeding of European and North American strains of *P. ostreatus* var. *ostreatus* and *P. ostreatus* var. *columbinus*, it can be concluded that *P. ostreatus* var. *columbinus* is an independent species, so it must be considered as:

Pleurotus columbinus Quél., apud. Bres., Fungi Trid. 1, p. 10, 1881
Synonyms:
" *P. columbinus* Bres., Fungi Trid. 1, tab. VI, 1881"
P. ostreatus var. *columbinus* (Quél.) Pilát, Champ. Europe, p. 120, 1935
P. ostreatus var. *columbinus* (Quél.) Quél. s. auct.

Eger *et al.* (1979) considered *P. columbinus* as a simple "form" of *P. ostreatus*, with blue pileus. Certainly, under culture conditions the basidiomata of *P. columbinus* frequently lose the characteristic blue colors, but under natural conditions or when grown outside the mushroom farm, the pileus always developes blue colors. According to the bibliography, *P. columbinus* probably is more frequent in coniferous woods and *P. ostreatus* in deciduous woods. *P. pulmonarius* is the correct epithet to the commercial strain known as "*Pleurotus ostreatus* var. *florida*" or "*Pleurotus florida*", actually both nomina nuda. *Pleurotus floridanus* (Stamets and Chilton, 1983) is obviously a misidentification. *P. sajorcaju* is unknown in American Continent, and some commercial strains of *P. ostreatus* have been misidentified with that paleotropical species.

As for cystidioid elements observed in the three studied species, these elements are of no taxonomic value and agreed well with structures described by Hilber (1982) in *P. ostreatus* var. *ostreatus* and *P. ostreatus* var. *columbinus* as " unfunctional basidia, supporting conidia ". Hilber considered these elements erroneously as **caulocystidia**, but they are born from lamellae extended over the stipe, as he shows in the illustrations (eg. Fig. 124) where a reduced hymenium is represented. This author also called these structures as "reduced hymenial elements like, supporting globose conidia, 2.6 μm in diam., with ability of reproduce asexually", but in figure 135 he shows mucilaginous drops sheathing the apex, as the writers observed in the studied materials. Probably the cystidioid elements could, in fact be aberrant basidia produced under culture conditions, as observed in anamorphs of *Pleurotus smithii* (Guzmán *et al.*, 1980, fig. 5).

In relation to basidiomata color, light affects significantly on its variation. Bresinky *et al.* (1977) observed that differences between *P. ostreatus* and *P. columbinus* on basidiomata color, when grown at low temperatures and high intensities of light, appear whitish. *P. ostreatus* var. *ostreatus* grown at the mushroom farm, either inside under indirect natural ilumination or outside under direct natural ilumination, presented different colors; it was observed that the characteristic grey, lilaceous-gray, greyish-brown or blackish colors of pileus, vanished inside the mushroom farm, while those outside developed the characteristic colors. *P. columbinus* grown outside the mushroom farm presented more intense blue colors than those grown inside, these latter were pale brownish-buff, similar to those of *P. ostreatus*, while *P. pulmonarius* is whitish or ivory-white when grown inside, but pale brownish-buff under natural illumination.

Basidiomata form tend to vary also under culture conditions. The typical form in studied species is shell-like. However, under poor aeration, high concentrations of CO_2 and bad illumination, stipitate forms, with infundibuliform pileus and deeply decurrent lamellae are developed, so the basidiomata form is not a good taxonomic character on species diagnosis in *Pleurotus*, but most basidiomata of *P. pulmonarius* showed a tendency to have a well developed and ramified stipe, not observed in *P. ostreatus* neither on *P. columbinus*, although this later tends to present ± well developed stipes, but never ramified. The stipitate ramified form of *P. pulmonarius* is somewhat like *P. cornucopiae* Paul. : Fr. (= *P. cornucopioides* Pers.), a species known poorly in the American Continent.

Key to species of *Pleurotus ostreatus*- complex

1a. Pileus dark grayish-blue, grayish-blue or grayish to steel grayish. Spores 8-11.2 (-12) μm length. Hyphae thick walled, up to 2.4 μm. Common in coniferous forests in Europe and North America (unknown in Mexico) . . . . *P. columbinus*

1b. Pileus without bluish tones 2

2a. Pileus dark grayish-brown to pale grayish brown. Spores 8-10.4 (-11.2) μm long. Hyphae thin walled, up to 1.6 μm. Common in deciduous temperate forests in Europe and North America (unknown in Mexico) . . . . *P. ostreatus*

2b. Pileus pale grayish-brown to ivory-white.Spores 7.2-11 (-12) μm long. Hyphae thick walled, up to 2.4 μm. Common in subtropical or deciduous forests (not in Mexico) . . . . *P. pulmonarius*

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OMPHALINA SENSU LATO IN NORTH AMERICA 1-2.
1: OMPHALINA WYNNIAE AND THE GENUS CHRYSOMPHALINA
2: OMPHALINA SENSU BIGELOW

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ABSTRACT: The four year observation of an Oregon population of *Omphalina wynniae* has facilitated reevaluation of its generic placement and that of other North American omphalinoid agarics. In Part 1, the species is illustrated and described in detail, its nomenclatural history discussed, and the new combination ***Chrysomphalina grossula*** proposed for it. The genus *Chrysomphalina* is reevaluated: new combinations ***C. chrysophylla* var. *salmonispora*** and ***C. chrysophylla* var. *hoffmanii*** are made; *Gerronema strombodes* is removed from *Chrysomphalina* and the new combination ***G. xanthophyllum*** is made for a vicariant European taxon which has been confused with *G. strombodes.* A key to the known species and varieties of *Chrysomphalina* is presented. In Part 2, the division of *Omphalina* sensu Bigelow and the generic concepts of *Gerronema, Haasiella, Omphalina, Phytoconis, Pseudoarmillariella,* and *Rickenella* are discussed. New combinations are ***Omphalina hohensis*** and ***O. marchantiae,*** and ***Hygrocybe luteo-omphaloides nom. nov.*** is proposed for *O. occidentalis.* A key to generic segregates of *Omphalina sensu* Bigelow and expanded generic descriptions are provided.

KEY WORDS: Basidiomycetes, Agaricales, Tricholomataceae, *Camarophyllus, Chrysomphalina, Clitocybe, Gerronema, Haasiella, Hygrocybe, Omphalina, Phytoconis, Pseudoarmillariella, Rickenella,* Pacific Northwest, nomenclature, new combinations, generic key, anatomy, ecology, morphology

Introduction

Since Bigelow's 1970 monograph of the genus *Omphalina* in North America, several revised classifications of the species he treated have been published. One of the species, *O. wynniae* (Berk. & Br.) Ito, is rare, and on this continent is geographically restricted in distribution. Fresh material was not available to Bigelow; however, the availability of living material in Oregon has allowed us to study the species and its generic placement in detail (Part 1), which in turn has prompted reconsideration of the generic concepts of other North American omphalinoid agarics (Part 2).

Methods: Microscopical data were taken either from fresh material, observed in water, or dried basidiomes, rehydrated and mounted in Melzer's reagent or 3% KOH. Capitalized color notations are from Ridgway (1912). Collections cited under 'SPECIMENS EXAMINED' are deposited in the University of Washington Herbarium (WTU) unless otherwise stated. Herbarium abbreviations are from Holmgren et al. (1990). Norvell collection numbers start with initials, year, month, and day, i.e. LLN 92.10.28-3 = *Oct. 28, 1992,* 3rd collection.

Part 1. *OMPHALINA WYNNIAE* AND THE GENUS *CHRYSOMPHALINA*

Weekly monitoring of an Oregon population of *O. wynniae* from 1990 to 1993 facilitated reevaluation of the generic placement of the species, with macroscopic and microscopic features, pigmentation, and biology all supporting its placement into the segregate genus, *Chrysomphalina* Clç. Additionally, a review of the literature revealed the existence of an earlier name, *Agaricus grossulus* Persoon, for the taxon.

A detailed consideration of generic placement follows a complete species description and nomenclatural discussion.

CHRYSOMPHALINA GROSSULA (Pers.) comb. nov.

Figs. 1-7

Basionym: *Agaricus grossulus* Pers. Mycol. Eur. 3: 110. 1828.

≡ *Omphalina grossula* (Pers.) Sing. Persoonia 2(1): 29. 1961.
≡ *Camarophyllus grossulus* (Pers.) Clç. Beih. Z. Mykol. 4: 55. 1982.
≡ *Gerronema grossulum* (Pers.) Sing. Beih. Sydowia 7: 14. 1973.

= *Agaricus umbelliferus* var. *abiegnus* Berk. & Br. Ann. Mag. Nat. Hist. Ser. 4, XV: 28, #1143. 1875.
≡*Omphalia abiegna* (Berk. & Br.) J. Lange. Dansk. Bot. Arkiv 6: 13. 1930.
≡ *Omphalina abiegna* (Berk. & Br.) Sing. Lilloa 22: 212. 1951.

= *Hygrophorus wynniae* Berk. & Br. Ann. Mag. Nat. Hist. Ser. 5, III: 208, #1781. 1879.
≡ *Omphalia wynniae* (Berk. & Br.) Quél. C. R. Assoç. Franc. Av. Sci. (La Rochelle, 1882) p. 390. 1883.
≡ *Omphalina wynniae* (Berk. & Br.) Ito. Myc. Fl. Japan 5(2): 128. 1959.

= *Omphalina bibula* Quél. Ench. Fung. p. 44. 1886.

≡ *Omphalia bibula* (Quél.) Sacc. Syll. Fung. 5: 324. 1887.

=*Omphalina umbellifera* var. *citrina* Quél. Ench. Fung. p. 44. 1886.

= *Omphalia bibula* var. *citricolor* Rolland. Bull. Soc. Myc. France 7: 94. 1891.

≡ *Omphalia bibula* f. *citricolor* (Rolland) Konr. & Maubl. Icon. Sel. Fung. p. 288. 1934.

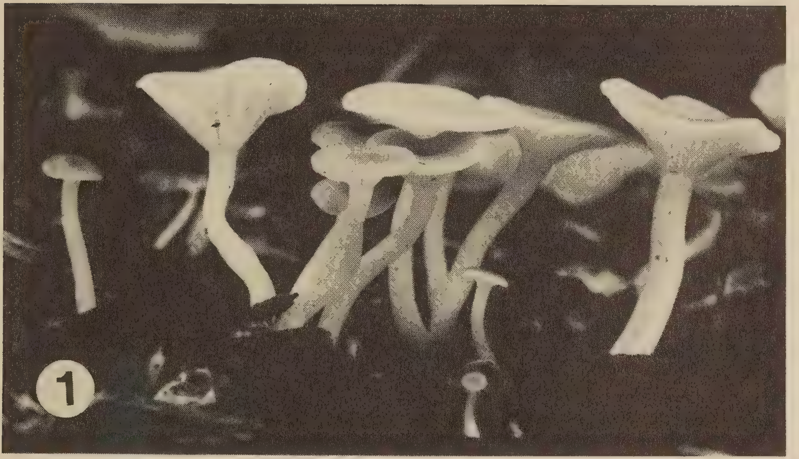


Fig. 1. *Chrysomphalina grossula* (LLN 92.10.25-4) *in situ*.
Approximately actual size.

Selected descriptions and illustrations: NORTH AMERICA: Bigelow (1970, 25-26, Fig. 10 as *Omphalina wynniae);* Phillips (1991, 76-77 as *Omphalina wynniae);* Smith (1937, 481 as *Omphalia abiegna);* EUROPE: Breitenbach & Kränzlin (1991, 100-101 as *Camarophyllus grossulus)*; Clémençon (1982, 58 as *Camarophyllus grossulus);* Cooke (1886. Pl. 905 [911], Fig. A as *Hygrophorus (Hygrocybe) wynniae);* Josserand (1955: 74-76 as *Omphalia abiegna);* Konrad & Maublanc (1933: Pl. 235, Fig. 2 as *Omphalia wynniae);* Kühner & Romagnesi (1953, 123 as *Omphalia abiegna*); Moser (1983, 98 as *Omphalina grossula);* Persoon (1828,110, Tab XXVI Fig. *6* (NOT Fig. 2) as *Agaricus grossulus*); Quélet (1886, 44-45 as *Omphalina umbellifera* var. *citrina*); Rolland (1891, 94-95 Pl. VI, Fig. 1 as *Omphalia bibula* var. *citricolor);* Ryman & Holmåsen (1984, 260 as *Omphalina grossula*); AFRICA: Malençon & Bertault (1975: 202-204 as *Omphalina abiegna*); ASIA: Ito (1959, 128 as *Omphalina wynniae)*; Kawamura (1929, No. 58 & 1954, 314 (Fig. 311) both as *Hygrophorus wynniae*).

PILEUS: 2-35 (60) mm, convex to plano-convex with incurved margin when young, becoming convexo-umbilicate to uplifted with age; extreme margin even, crenate or occasionally sulcate; **surface** moist, hygrophanous, striate from disc to extreme margin, glabrous; **color** of disc and striations initially yellow to brownish yellow or greenish yellow (Wax Yellow, Citron Yellow, Old Gold, Olive Lake), with age becoming paler (Citrine, Old Gold, Olive Lake) or even whitish, color of margin yellow to greenish yellow (Wax Yellow, Massicot Yellow, Citron Yellow, Pyrite Yellow), with extreme age entire cap almost white; **context** thin (1 mm over gills), pale yellow (near Massicot Yellow). **LAMELLAE:** strongly decurrent, initially ending at the same point on stipe apex, distant (L + l ca. 9/cm at edge and

5/cm at midpoint), arcuate, 1-1.5 (3) mm broad, 0.5-0.8 (1.0) mm thick; often intervenose, lamellulae 1- or 2-tiered, regularly interspersed; edges even; **color** generally yellow to greenish-yellow (Marguerite Yellow, Citron Yellow, Pyrite Yellow, Sulphur Yellow) becoming slightly paler to whitish on exposure or with age. **STIPE:** central, 5-40 (55) mm long, more or less equal 1.5-7 (10) mm at apex, evelate, usually hollow; **surface** appearing glabrous to the naked eye, appearing sparsely minutely pubescent under magnification; **color** overall yellow or greenish-yellow (Massicot Yellow, Citron Yellow) gradually paling toward base with age; **context** pliable, pale yellow (Massicot Yellow). **Odor and taste** not distinctive. **SPORE PRINT** whitish in thin deposits.

SPORES: 5.9 - 9.6 X 3.7-5.5 (6) µm, ellipsoid to subellipsoid with conspicuous obtuse apiculus (Fig. 3); hyaline, smooth, thin-walled, inamyloid, frequently containing one large central oil droplet when fresh and viewed in water or KOH [dried spores older than ten years contain many small droplets]. **BASIDIA:** 33-48 X 5-8 µm, 4-spored (rarely 2-spored), cylindrical to narrowly clavate with sterigmata ranging in length from 3 - 7.4 (10) µm; packed with the basidioles into a dense hymenial layer (Fig. 4); ratio of basidioles to sterigmate basidia very high. **HYMENIAL CYSTIDIA:** absent. **OLEIFEROUS HYPHAE:** flexuous, with dense, yellowish refractive contents, 4-6 µm diam, occasionally present in all tramal tissues and in the stipitipellis. **CLAMP CONNECTIONS:** absent throughout the basidiome.

PILEIPELLIS: in radial section a cutis of compact parallel to subparallel, broadly cylindrical, repent, frequently septate hyphae (3)-6-13 µm diam; (occasionally branching or fusing with other elements in age); occasional cylindrical to tapered cystidioid elements with rounded apices exserted from the surface (Fig. 6); hyphal walls thin, smooth, neither gelatinized nor with incrusted pigments, and with slight banding from presence of intraparietal pigment; faint brownish-yellow intracellular pigments present when viewed in water. **PILEAL TRAMA:** a loosely radiating mesh-like structure of septate, hyaline, smooth, thin-walled, nongelatinized hyphae, 8-20 (22) µm diam, often ampullaceous at septa, giving many cells a femur (bone-like) shape (Fig. 5).

HYMENOPHORAL TRAMA: mature lamellae in cross section with a relatively wide mediostratum of greatly inflated cells similar to those in the pileal trama bracketed by a thin layer of narrow descending hyphae giving rise to the subhymenium, the latter of perpendicular hyphae branched in a candelabra-like manner which give rise to the basidia (Fig. 4). [In young lamellae the mediostratum is composed of parallel to subparallel hyphae (the parallel alignment being more noticeable in the central portion) which become highly inflated (>12 µm diam) in older lamellae; hyphal walls smooth, thin, neither gelatinized nor incrusted; yellowish intracellular pigment present throughout; bracketing subhymenium of 1-4 individual strands of parallel, narrow, cylindrical, septate hyphae 10 µm diam, with age becoming more sinuous, less regular and obscured by inflated hyphae of the mediostratum (often visible only in squash mounts); perpendicular to these strands, a layer of irregularly shaped di-/ trichotomously branched inflated hyphal elements, 3-5 µm diam, each giving rise to 2-3 basidioles, basidia, or other subhymenial elements; this candelabra-like layer, 20 µm wide in young specimens, with basidia arising from different levels.]

STIPITIPELLIS: a cutis of repent, subparallel, somewhat inflated, septate hyphae 3.7 - 12.5 (17) µm diam, with occasional exserted cystidioid elements (Fig. 7); pale yellowish intracellular pigment present; walls thin, smooth, neither gelatinized nor pigment-incrusted. **STIPITITRAMA:** composed of inflated, septate, hyaline, thin-walled vesicular hyphae 8-22 µm diam.

ECOLOGY AND DISTRIBUTION: gregarious to caespitose on water-soaked coniferous wood, bark chips, debris (occasionally found on angiosperm wood mixed with colonized coniferous wood) in mixed forests or parks at elevations from 30 m to 1100 m. *Chrysomphalina grossula* (as *Omphalia abiegna)* was first reported in North America from Washington state (Smith, 1937). In North America this species is uncommon, restricted to the *Tsuga heterophylla/Pseudotsuga menziesii* zone of the Pacific Northwest where it is normally found in small numbers on coniferous debris. A report from Alberta by Schalkwyk-Barendsen (1991) was based on a collection of *Clitocybe,* sect. *Candicantes* [specimen in DAOM examined].

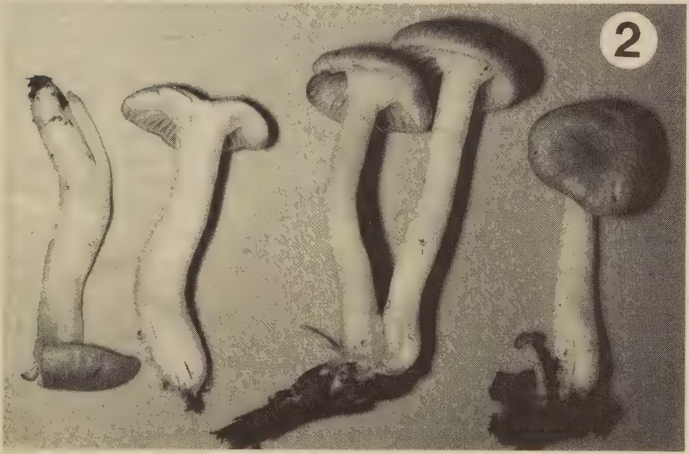


Fig. 2. Young, more darkly colored *Chrysomphalina grossula* basidiomes exhibiting hollow stipe (LLN 90.10.20-2). Slightly larger than natural size.

NORTH AMERICAN SPECIMENS EXAMINED: CALIFORNIA: Humboldt Co, Arcata -- *XII.18.1986* BLT 606 (HSC). **IDAHO: Bonner Co,** Nordman -- *X.6.1956* AHSmith 54126 (MICH); *X.8.1956* AHSmith 54271 (MICH); *X.11.1956* AHSmith 54452 (MICH); *IX.23.1964,* AHSmith 70705 (MICH); Priest Lake -- *IX.10.1966* RWatling 2892 (E); *IX.29.1968* AHSmith 76757 coll. RHPetersen (MICH); **Shoshone Co** -- *IX.21.1966* OKMiller 3351 (E). **OREGON: Clackamas Co,** Mt. Hood -- *X.3.1946* AHSmith 24026 (MICH); **Lincoln Co,** Van Duzer State Park -- LLN 92.11.10-2; **Multnomah Co,** Portland -- LLN 90.10.20-2; LLN 90.10.28-1,2,3,4,5; LLN 90.11.26-3; LLN 91.04.07-1,2; LLN 91.05.12-1; LLN 91.11.19-1 (DAOM); LLN 91.11.23a-c; LLN 92.01.02-1,2 coll. OLNorvell 3 (DLamoure pers. herb.); LLN 91.01.12-1; LLN 92.01.25-1; LLN 92.01.31-2; LLN 92.02.07-1,2,3,4,5,6; LLN 92.02.29-1; LLN 92.04.19-1; LLN 92.04.28-3,4; LLN 92.05.02; LLN 92.05.03-3; LLN 92.11.10-1 coll. GTNorvell; LLN 93.04.11; LLN 93.04.18-1,2,3,4,5; LLN 93.04.25-1,2. **WASHINGTON: Clallam Co,** Lake Crescent -- *X.9.1935* AHSmith 3059 (MICH); *X.13.1935* AHSmith 3123 (MICH); **Columbia Co,** Tucannon River -- *IX.22.1984* JFAmmirati 9014; **King Co,** Seattle --LLN 90.11.26-4 coll. DVBark; LLN 90.12.11-2 coll. DVBark; **Lewis Co,** Longmire -- *VIII.1.1948* AHSmith & DEStuntz; **Pierce Co,** Green Lake -- *X.2.1952* AHSmith 40415 (MICH); *X.19.1952* Stuntz 7554 AHSmith; Mt. Rainier Natl Park, Lower Tahoma Creek -- *X.22.1972* JWLennox 1412; **Whatcom Co,** Mt. Baker National Forest, Noisy Creek Preserve -- LLN 92.03.28-1 coll. JFAmmirati.

EXTRALIMITAL SPECIMENS EXAMINED: CZECHOSLOVAKIA: Mt. Boubin Nature Reservation -- *IX.28.1970* RSinger C5205 (F). **SCOTLAND: Hanzyll**, Ben More Garden -- *IX.6.1963* DMHenderson 7087 (E); **Herefordshire**, Covenhope -- *XI.21.1959* PDOrton 2062 (E); **Invernesshire,** Cullodon Visitor Center -- *X.20.1989* RWatling 21679 (E); **Keltshire**, Black Craig --*VII.25.1970* RWatling 7618 (E); **Lothenchurch,** Lachane -- *IX.13.1957* RWatling 37C (E); **Perthshire,** Rannoch, Dall -- *X.7.1976* PDOrton 4855 (E); Straloch -- *VIII.18.1978* RWatling 12844 (E); **Skye,** Treaslane -- *X.21.1980* AP & FM Bennell NG 394524 (E). **SWEDEN: Lena Parish,** Storveta --*IX.28.1937*: SLundell *ex Fungi Exsicc. Suec #517* (BPI); SLundell, det. RSinger 5563 (F); **Småland,** Nassjo Parish, [Stuntamalen] -- *X.9.1945* G Haglund 572 (MICH); **SWITZERLAND: Maschwanden/ZH** Meggenwald -- *X.20.1975* FKränzlin 2010-75 K1 (LU); Obfelden/Oberholz --*XII.11.1988* JBächler 1112-88BA1 (LU).

Observations and Notes

In 1981 brilliant yellow basidiomes of *Chrysomphalina grossula* were noticed in a forested garden on the outskirts of Portland, Oregon. In September of 1990, the species reappeared. A few basidiomes were found approximately 150 feet away from the original site on a trail leading into a second-growth forest. In both instances the fungus occurred on chipped bark imported to the garden for use as mulch. During the first few months following its reappearance, the current population expanded from its original location along the path for approximately fifteen feet. Subsequently in the summer of 1991 basidiomes extended over 150 feet in large numbers over the entire length of the trail; spread of the original population, now extending over a distance of 700 feet, has continued to the present time.

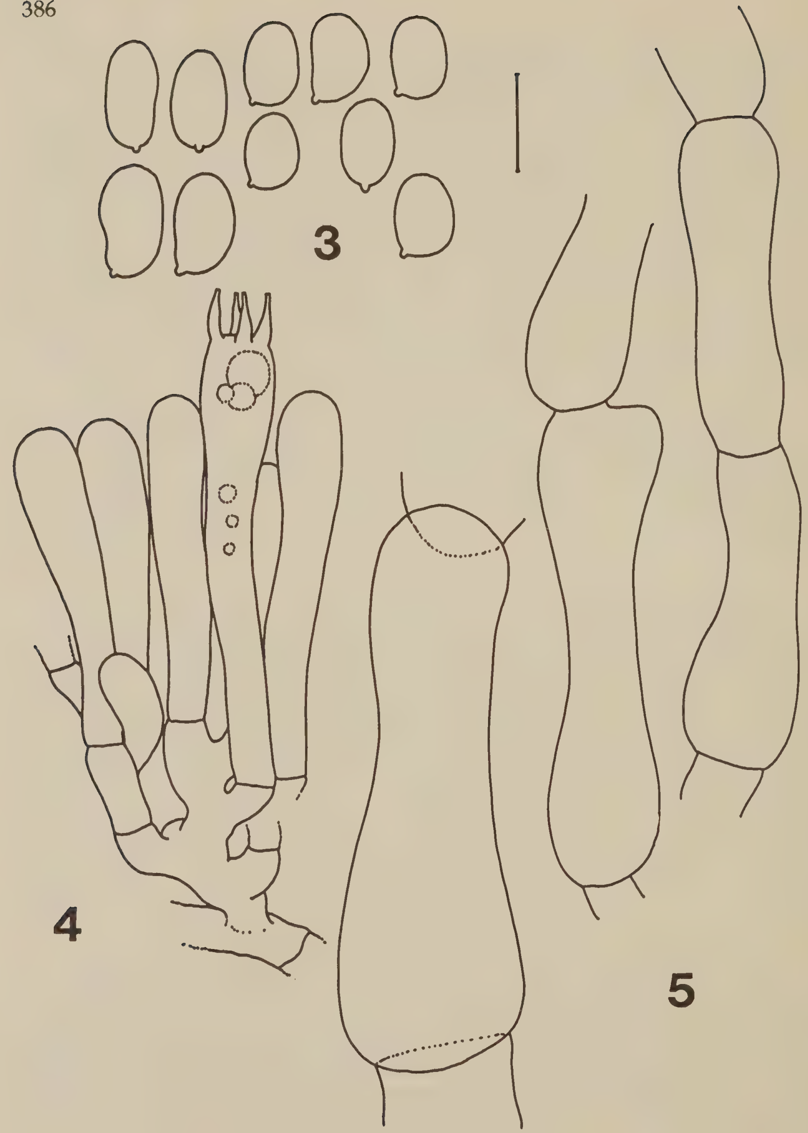
Observations of individual basidiomes over time have revealed that this species exhibits considerable color variation throughout its development. The basidiomes are long-lived; some specimens have been observed *in situ* for over a month. The greatest intensity of color, a brilliant greenish-yellow, occurs upon emergence from the substrate. Throughout this period the pileus and stipe base gradually lose pigments. Intense coloration is lost from the more exposed areas; the pilei tend to fade from an intense olive-yellow through greenish-brown or tan to almost white, while more protected areas of the basidiomes, such as the lamellae and stipe apex, retain an intense greenish-yellow hue for a much longer time. Eventually the entire basidiome can become pallid. This developmental color variation is paralleled by differences in innate pigmentation: instances of partial albinism, where yellow pigments are missing from the onset, also have been observed in the Oregon population (LLN 90.10.28-2, LLN 91.11.23c, LLN 93.04.18-1&2.). This variability of the intrinsic color found in different forms of *C. grossula* was noted by Josserand (1955), who also commented on the occurrence of a double-pigment system: one citrine, the other a bister-fuscous.

The lamellae thicken considerably over the life of the basidiome; as a result the lamellar trama varies from subregular to irregular depending upon the disruption caused by inflation of the hyphae in the mediostratum (Fig. 5). Simultaneously the hymenium thickens slightly. At any given time there are few sterigmate basidia relative to basidioles (Fig.4); this is due to the continual rejuvenation of the hymenium over the extended life-span of the basidiome.

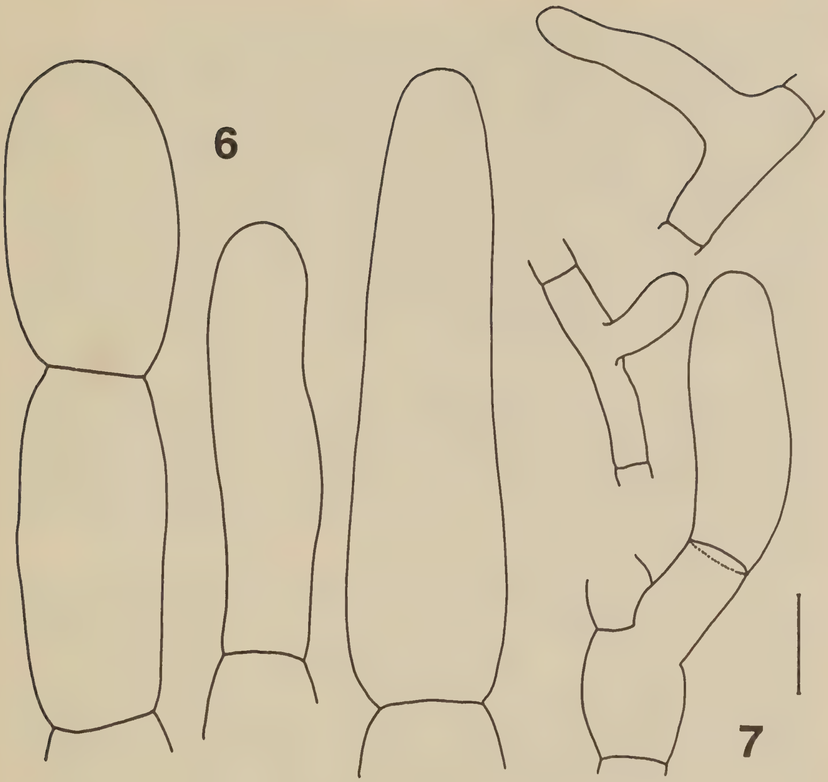
The range in size of the individual basidia in *C. grossula* is similar to that observed in *C. chrysophylla* (Fr.) Clç. In his discussion of subhymenial and basidial development in that fungus, Kühner (1928) remarked "each cell of the subhymenium gives rise to an ascending crooked lateral branch which in turn leads directly to a basidium or to a new subhymenial cell; it follows that the basidia -- arising as they do from extremely variable depths -- are of very different lengths...." (translated by LLN). *C. grossula* also has a candelabra-like subhymenium, but it is not as strongly developed. Josserand (1955) drew attention to the similar hymenial development in *C. chrysophylla* (as *Omphalia)* and *C. grossula* (as *O. abiegna).* He noted that this developmental pattern led to an abundance of immature elements in the hymenium, resulting in a low level of spore production. These observations explain the difficulty in obtaining satisfactory spore deposits for either species.

Oregon basidiomes of *C. grossula* produced scant spore deposits; a thin deposit on paper is creamy-white; deposits on one microscope slide appeared very slightly greenish. In his descriptions of the species (as *O. wynniae* in 1882 and *O. bibula* in 1888) Quélet described a white or greenish spore print (*"hyaline ou verdâtre").* After obtaining sufficiently heavy spore deposits (only twice over a 21 year period), Josserand (1955) noted a very pale (*"trés, trés pale")* creamy-greenish color when the print was compared to a very white standard, bicarbonate of soda.

Possibly because of similarity in size, habit, overlapping habitats, and color when faded, *C. grossula* has been confused with another clampless species, *Phytoconis ericetorum* (Fr.) Redhead & Kuyper (also variously known as *Omphalina ericetorum* (Fr.) M. Lange or *Omphalia umbellifera* (Fr.) Kumm.). Older faded forms of both species can be microscopically



Figs. 3-5. *Chrysomphalina grossula.* **Fig. 3.** Basidiospores. (LLN 92.04.19-1). **Fig. 4.** Candelabra-like subhymenium with irregularly shaped di-/trichotomously branched hyphal elements giving rise to a dense hymenial layer with basidioles and basidium. (LLN 93.04.18-1). **Fig. 5.** Femur-like hyphal cells from pileal trama (LLN 93.04.18-1). Scale = 10 µm.



Figs. 6-7. *Chrysomphalina grossula.* **Fig. 6.** Exserted cystidioid end cells from pileipellis (LLN 93.04.18-1). **Fig. 7.** Exserted cystidioid elements on stipe (LLN 93.04.18-1). Scale = 10 µm.

differentiated: hyphae in the pileal and lamellar trama of *C. grossula* are markedly inflated (reaching 22 µm in diameter) and constricted at the septa (cf. Fig. 7) while those of *P. ericetorum* are narrower (4-10 µm) and not normally swollen at the septa [cf. Bigelow, 1970]. Additionally, *P. ericetorum* is lichenized with the basidiomes surrounded by a thallus composed of small sphaerules. This species, unlike *C. grossula,* frequently develops a fairly conspicuous pubescent vestiture on its stipe.

Choice of Species Epithet

The highly variable coloration and thickening lamellae of *C. grossula* have contributed to the generation of several species epithets. Persoon (1828) named the mushroom *Agaricus grossulus,* selecting a species epithet referring to the gooseberry green coloration. The fungus was later described as a pale yellow variety of *Agaricus umbelliferus* by Berkeley & Broome in 1875 (as var. *abiegnus*), probably based on aged, partially faded specimens; the name "*abiegnus*" refers to its normal substrate, coniferous wood. The species in its lemon-yellow state, a coloration common in *Hygrophorus sensu lato*, was next described as *Hygrophorus wynniae* by Berkeley & Broome in 1879 who named it after the collector, Mrs. Lloyd Wynne. Apparently this assignment to *Hygrophorus* obscured the fact that the authors had earlier described the same agaric as an omphalioid taxon.

Quélet (1886) simultaneously assigned the species two names: *Omphalina umbellifera* var. *citrina* for the more mature lemon-yellow colored form, and *Omphalina bibula,* a reference to its bibulous nature, for the more intense, younger olive-citrine colored form. In 1888 Quélet treated *O. wynniae* as conspecific with *O. bibula.* Rolland (1891) named what he believed to be a new yellow-colored form of the olive-citrine fungus *Omphalia bibula* var. *citricolor.*

Lange (1930) transferred *A. umbelliferus* var. *abiegnus* to *Omphalia* at the species level, treating *H. wynniae, Omphalina bibula* and *O. umbellifera* var. *citrina* as synonyms. After examining the type of *A. grossulus,* Singer (1961b) placed both *O. abiegna* and *O. wynniae* in synonymy with *A. grossulus*, transferring the species to *Omphalina.* Clémençon (1982) accepted Singer's synonymy but placed the taxon into *Camarophyllus* (q.v.). Both the macroscopic description by Persoon (1828) and the microscopic description of the type by Singer (1961b) are consistent with our concept of the species.

***Agaricus chrysoleucus* Pers.:** Several authors have considered *Agaricus chrysoleucus* Persoon (1801) to be an earlier name for the fungus we call *C. grossula.* We do not accept this synonymy.

Lange (1930) treated *A. chrysoleucus* (as *Omphalia umbellifera* var. *chrysoleuca* Pers.) as a synonym of *O. abiegna,* although he acknowledged that there was confusion regarding Fries' concept of the latter. Konrad & Maublanc (1934) listed *Omphalia umbellifera* var. *chrysoleuca* Pers. [*non* Fries] as a synonym of *Omphalia wynniae.* They additionally recognized var. *bresadolae,* listing *O. bresadolae* R. Maire, *Clitocybe xanthophylla* Bres., and *Omphalia hypoxantha* Bres. as synonyms. However, *A. chrysoleucus* as originally described by Persoon in 1801 has more characters in common with the fungus currently named *Gerronema strombodes* in Europe than with *C. grossula.* Persoon's *A. chrysoleucus* was said to be cespitose on conifer trunks in the Harz Mountains. Colors of the pileus, lamellae, and stipe were described as *"albido... distantibus sulphureis...albo"* respectively. *Clitocybe xanthophylla* Bresadola (1881), considered synonymous with *G. strombodes* (Beardslee 1917, Singer 1970, Clémençon 1982a, Breitenbach & Kränzlin 1991), was also described as cespitose on conifer trunks in the Italian Alps

(Bresadola 1881, 1928). Its protologue reads very much like that for *A. chrysoleucus:* Pileus *"griseocanus"*, lamellae *"distantes...laete flavae"*, and stipe *"albo-griseus"*. We believe *A. chrysoleucus* is more likely to be synonymous with *Clitocybe xanthophylla* than with *C. grossula.* However, even this synonymy is questionable (cf. below).

Fries (1818) appears to have misapplied the name *A. chrysoleucus* Pers. to a species having broad yellow lamellae and occurring on bare earth in Sweden, and subsequently (Fries 1821) applied the name *A. chrysoleucus* to yet another species with a deeply umbilicate pileus and narrow lamellae. By 1830 Fries considered *A. chrysoleucus* a dubious species, possibly a form of *Agaricus melizeus.* Later Fries (1832) listed *A. chrysoleucus* twice with two different authorities, "Pers." and "Fr.", in the index to the *Systema Mycologicum*, clearly indicating that he had earlier misapplied the name *A. chrysoleucus* to a different fungus from that described by Persoon. In 1838 Fries no longer synonymized *A. chrysoleucus* Pers. with the hygrophoroid *A. melizeus,* considering the former a yellow-gilled lignicolous form of *A. umbelliferus* [possibly *Phytoconis luteovitellina* (Pilát & Nannfeldt) Redhead & Kuyper]; at this time he recognized *A. chrysoleucus* Fr. as a distinct taxon. The lignicolous yellow-gilled form described by Fries (1838) may have been either a *Gerronema* or *Chrysomphalina.*

Given this history of confusion, we prefer to drop the name *A. chrysoleucus* from usage, considering it a *nomen confusum.*

Generic placement

The taxon under discussion has most often been treated as an omphalinoid species. For instance, Bigelow included *C. grossula* in *Omphalina* as *O. wynniae.* while Singer, after initially (1961b, 1962) placing it in *Omphalina* as *O. grossula,* later incorporated the species in *Gerronema* (Singer 1975, 1986). Bigelow and Singer's differing circumscriptions of *Omphalina* and selected segregate omphalinoid genera will be fully explored in Part 2.

Some authors, however, have emphasized the similarities between *C. grossula* and hygrophoraceous species. Clémençon (1982b) placed *C. grossula* into *Camarophyllus* subgenus *Aeruginospora* because it appeared to have a highly irregular hymenophoral trama and because the basidiomes sometimes appear slightly greenish, linking it to the putatively green-spored type of the subgenus. As typified by *C. pratensis* (Pers.: Fr.) Kumm., *Camarophyllus* is a typically hygrophoraceous genus with elongated basidia characterized by having a distinctly irregular lamellar trama and a terrestrial habit. Out of the five *Camarophyllus* sections accepted by Singer (1986), only section *Aeruginospora* is characterized by clampless hyphae. Notably all three species included by Singer in this section are not lignicolous, which clearly makes inclusion of the lignicolous *C. grossula* an anomaly. Furthermore, *C. grossula* does not have a typically irregular lamellar trama. In our opinions, the species is not closely allied to *C. pratensis* and does not belong in the Hygrophoraceae. Kuyper (1986) reached a similar conclusion in his cladistic analysis of European omphalinoid genera.

CHRYSOMPHALINA CLÉMENÇON

Given the anatomical similarities between *Chrysomphalina grossula* and *C. chrysophylla* outlined earlier, we consider the two species to be congeneric. *Chrysomphalina chrysophylla* is the type species for the genus *Chrysomphalina* Clç. (*non* Haas, see Redhead 1986). Clemençon (1982a) validated *Chrysomphalina* to accommodate two omphalinoid species, *C. chrysophylla* and *C. strombodes* (Berk. & Mont.) Clç. We interpret the genus differently, restricting *Chrysomphalina* to species having a hymenium which thickens over an extended life-span by the production of basidia of different lengths on short subhymenial cells (see Clémençon 1982a, Kost 1986a, Kühner 1928). In *C. chrysophylla* the combination of hymenial thickening and short subhymenial cells was so conspicuous that Clémençon coined the term "pachypodial trama" for it. This tissue is formed, but to a lesser extent, in *C. grossula*. A third species, *C. aurantiaca* (Peck) Redhead, also exhibits this phenomenon; however, here the pachypodial trama is even less well-developed than in *C. grossula*. We consider the development of this type of hymenium to be not only taxonomically significant as emphasized by Clémençon, but indicative of a possible linkage to the Cantharellaceae, as suggested by Kühner (1928) and Kost (1986b) (See also Arpin & Fiasson 1971 and Tyler 1971). *Chrysomphalina*, as represented by the type species, also shares with *Cantharellus* the presence of intracellular carotenoid pigments (Arpin & Fiasson 1971, Kost 1986b, Kühner 1980). Other important features of the three *Chrysomphalina* species are monomitic tissues, strictly lignicolous habit associated with white rot, and the absence of clamp connections on all tissues.

Included in the genus are five taxa -- the type species *C. chrysophylla* with three varieties [*C. chrysophylla* var. *chrysophylla*, ***C. chrysophylla* var. *salmonispora* (Bigelow) *comb. nov.*** (Basionym: *Omphalina chrysophylla* var. *salmonispora* Bigelow. Mycologia 62: 22. 1970.), and ***C. chrysophylla* var. *hoffmanii* (Peck) *stat. et comb. nov.*** (Basionym: *Agaricus hoffmanii* Peck, New York State Mus. Rept. 24: 60. 1872.)], *C. aurantiaca*, and *C. grossula*.

Key to *Chrysomphalina* species

1. Basidiomes typically uniformly orange colored (pileipellis and stipitipellis concolorous with context; only bright yellowish to rosy orange pigments present); pileus margin fringed by hair-like concolorous scales, at least when young.................... ***C. aurantiaca***

1. Basidiomes typically bi-colored (pileipellis typically more darkly colored than context; both an intracellular brownish or greenish fuscous pigment and a yellowish or orange pigment present); pileus either glabrous or subglabrous, or if scaly, with darker scales confined to the central region **2**

   2. Basidiomes bright greenish-yellow when young, becoming yellower or paler with age but not exhibiting orangish hues at any stage; tramal cells frequently femur-like at maturity (cf. Fig. 7); basidiospores with broadly rounded ends (cf. Fig. 3) .... ***C. grossula***

2. Basidiomes with orange (orange, pinkish orange, or orangish yellow), never greenish tints; tramal cells rarely femur-like; basidiospores elongated, with many slightly tapered toward the apex (cf. Figs. 8-10) **3**

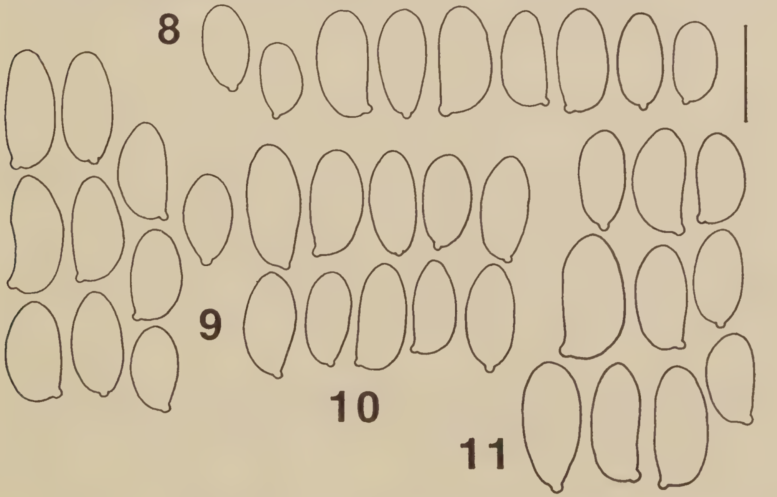
3. Pileipellis either glabrous or subglabrous, lacking dark scales on disc..***C. chrysophylla*** **var.** ***hoffmanii***

3. Pileipellis with definite dark scales on disc and inner margin...............**4**

4. Basidiomes with orange or orangish yellow tints, lacking pinkish or salmon tones......................***C. chrysophylla*** **var.** ***chrysophylla***

4. Basidiomes with pinkish-orange or salmon tones............................ ....***C. chrysophylla*** **var.** ***salmonispora***

We believe *C. chrysophylla* var. *salmonispora* may be a color variant with either different carotenoids or a different mixture of carotenoids from those found in *C. chrysophylla* var. *chrysophylla*. Although *C. chrysophylla* var. *hoffmanii* may be no more than a growth form, it is impossible to tell from current data whether the smooth pilear condition is genetically or environmentally controlled; some collections (e. g. Stuntz 9776) range from the glabrous to the scaly condition. Additionally the spores are virtually identical in all three varieties (Figs. 9-11) and differ subtly from *C. grossula* (Fig. 3) and *C. aurantiaca* (Fig. 8).



Figs. 8-11. Basidiospores. **Fig. 8.** *Chrysomphalina aurantiaca.* (LLN 93.08.03-3). **Fig. 9.** *Chrysomphalina chrysophylla* var. *chrysophylla.* (CArdrey 1429). **Fig. 10.** *C. chrysophylla* var. *hoffmanii* (SARedhead 7700). **Fig. 11.** *C. chrysophylla* var. *salmonispora* (LLN 93.08.03-2b). Scale = 10 µm.

Excluded species: In our classification, *Chrysomphalina strombodes* is not congeneric with *C. chrysophylla*. Microscopical examinations of both North American and European collections (see specimens examined) have revealed that taxa identified as *C. strombodes* on both continents form basidiomes composed of sarcodimitic tissues and therefore should be retained in *Gerronema*. Additionally, they represent two taxa: a North American species with minute dark brown to blackish appressed squamules on the pileus composed of fascicles of clavate to clavate-pedicellate pileocystidia with brown cellular contents (Fig. 14) and a European species with innately radiating fibrils, wholly lacking pileocystidia and resulting squamules. As the name *Gerronema strombodes* applies to the North American species (Fig. 12), originally described from Ohio, another name must be used for the European species (Fig. 13). Given our doubts about the name *A. chrysoleucus*, the next available epithet is *Clitocybe xanthophylla*, for which authentic material has been examined. We therefore propose for the European species the name ***Gerronema xanthophyllum* (Bres.) *comb. nov.*** [Basionym = *Clitocybe xanthophylla* Bres. Fungi Tridenti Vol 1: 8. 1881. Synonyms = *Omphalia hypoxantha* Bres. *nom. nov.* Icon. Mycol. VI. Tab CCLIX 1928. (*non Omphalia xanthophylla* (Berk. & Curt.) Sacc. Syll. Fung. 5: 312. 1887 = *Agaricus (Omphalia) xanthophyllus* Berk. & Curt. Ann. Mag. Nat. Hist: 4. 1859.) = *Omphalia bresadolae* R. Maire *nom. nov.* Ann. Mycol. 11: 338. 1913.]

SPECIMENS EXAMINED *Chrysomphalina aurantiaca:* NORTH AMERICA: ***CANADA*: BRITISH COLUMBIA: Glacier Natl Park,** Illecillewaet River -- *IX.9.1980* Redhead 3533 (DAOM 184112, *NEOTYPE). USA:* **CALIFORNIA: Mendocino Co,** Rockport -- *XII.31.1968* JWLennox 150'b. **WASHINGTON: Chelan Co,** Rainy Pass -- LLN 93.08.03-3, coll. JFAmmirati & TWKuyper; **Clallam Co,** Olympic Natl. Pk., Sol Duc Falls -- LLN 92.10.14-4, LLN 92.10.14-7; **King Co,** Redmond -- *XI.24.1979,* FVdBogart 3980. **Lewis Co,** Cispus -- *X.22.1972* Stuntz 17500; **San Juan Co,** Friday Harbor -- *XII.8.1974* SLibonati-Barnes 408; **Yakima Co,** White Pass: Clear Lake -- *VI.4.1989* JFA 9905 coll. LBaxter.

***Chrysomphalina chrysophylla var. chrysophylla:* NORTH AMERICA:** ***CANADA:* ALBERTA: Kanaskis Valley,** Marmot Creek Basin -- *VII.13.1972* RMDanielson 308 (DAOM 143591). **BRITISH COLUMBIA: Vancouver Island, Pacific Rim Natl Park,** Long Beach -- *IX.29.1979* SARedhead 3247 (DAOM 175260). **QUEBEC: L'Islet co,** Elgin Rd -- *X.19.1949* HACJackson (DAOM 84909). ***USA:* OREGON: Coos Co,** Beaver Hill Forest -- *X.24.1986* CArdrey; *IX.4.1989,* C. Ardrey 1429; **Multnomah Co,** Estacada -- LLN 91.12.30-4, coll. LLN & JRogers. **WASHINGTON: King Co,** Seattle -- *XI.12.1956* Stuntz 9776, coll. Bell & Stuntz; **Pierce Co,** Mt. Rainier Natl Park, Lower Tahoma Creek -- *IX.12.1948* Stuntz 4421, det. AHSmith; **San Juan Co,** Friday Harbor -- *IX.17.1979* FVdBogart 3920. **WYOMING: Teton Co,** Flagstaff Road -- *VIII.12.1987* JFAmmirati 9525.

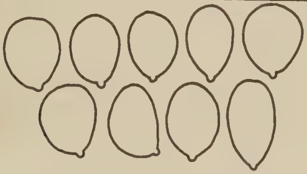
***Chrysomphalina chrysophylla var. hoffmanii:* NORTH AMERICA:** ***CANADA:* BRITISH COLUMBIA: Mt. Revelstoke Natl Park,** Illecillewaet Riv. -- *IX.27.1980* SARedhead 4124 (DAOM 181086). ***USA*: WASHINGTON: Ferry Co,** White Mountain, HWY 20 -- *VII.1.1993,* SAR 7700 coll. Ammirati, Norvell, Redhead & Seidl.

***Chrysomphalina chrysophylla var. salmonispora:* NORTH AMERICA:** ***USA:* WASHINGTON: Chelan Co,** Rainy Pass -- LLN 93.08.03-2b, coll. JFAmmirati.

Chrysomphalina grossula: *See under species description above.*

Gerronema strombodes: **NORTH AMERICA:** ***USA:*** **CONNECTICUT: New London Co**, Pachaug St. Forest. -- *VIII.4.1988* coll. unknown [N.E. Mycol. Foray] (DAOM 199314). **NORTH CAROLINA: Swain Co**, Great Smoky Mtns. Natl. Park -- *VII.19.1988* D.E. Desjardin 4616 (DAOM 199312).

Gerronema xanthophyllum: **EUROPE: ITALY:** --*1901* JBresadola (ex herb Bresadola, NY). **SWITZERLAND: Lucerne Cn:** Ruswil, Rotbachtobel -- *VI.15.1981* JBächler 1506-81 BA 5 (LU); Adlingenswil, Meggerwald -- *VII.13.1989* FKränzlin 1307-89 K 1 (LU).



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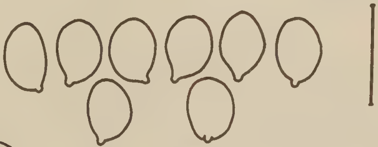

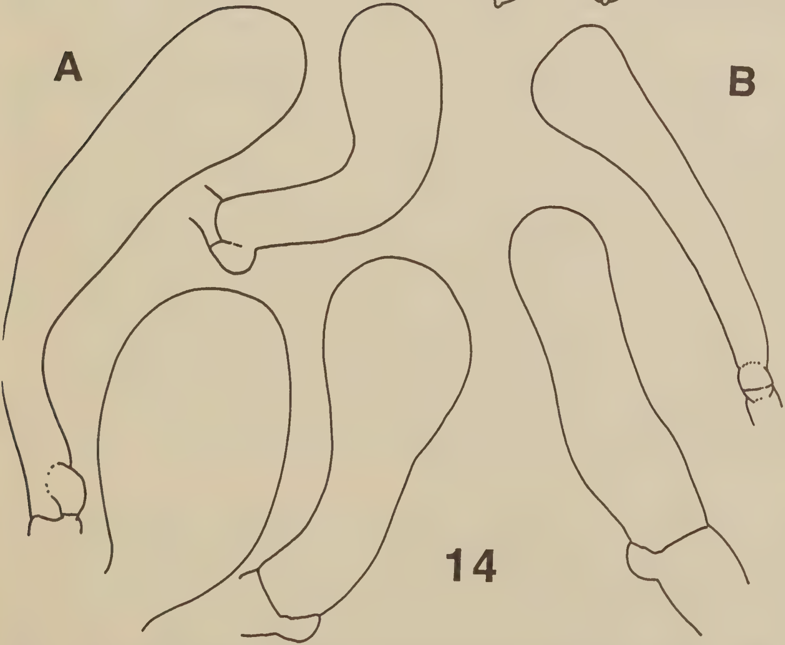

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Fig. 12. *Gerronema strombodes.* Basidiospores.(DAOM 199314). **Fig. 13.** *Gerronema xanthophyllum* Basidiospores. (LU FK 1307-89 K1). **Fig. 14.** Pileocystidia in *Gerronema strombodes.* **A.** (DAOM 199314). **B.** (DAOM 199312). Scale = 10 µm.

PART 2: *OMPHALINA sensu* BIGELOW

Omphalina was erected by Quélet (1886) for white-spored, centrally stipitate mushrooms with thin umbilicate or tubaeform pilei, decurrent lamellae, and cartilaginous stipes. From this macroscopical circumscription the terms "omphalioid" and "omphalinoid" were derived, i.e. "any mushroom [of small stature ≈ 1-2 cm diam.] with decurrent or subdecurrent gills, a cartilaginous stipe, a broadly convex to depressed pileus, a slightly to markedly depressed pileal disc, and lacking an annulus and a volva" (Largent & Baroni 1988).

Microscopical observations, however, suggest that this is a polyphyletic group, with parallel evolution having produced morphologically similar but anatomically distinct taxa. This view is consistent with recent segregations of genera from *Omphalina sensu lato* by taxonomists apparently seeking monophyletic genera within a more natural classification system.

Chrysomphalina, one such segregate genus, has already been outlined above. Other recently described or redefined genera (i.e. *Gerronema, Pseudoarmillariella, Haasiella, Rickenella,* and *Phytoconis)* are discussed below, followed by an evaluation of the genus *Omphalina* itself. A key to the genera as we accept them and expanded generic descriptions follow this discussion.

***GERRONEMA* Singer:** Singer (1951b) erected the genus *Gerronema* to accommodate three tenacious omphalinoid to clitocybeoid species from South America. He later (1964) transferred some species traditionally placed in *Omphalina* to *Gerronema.* Problems have arisen from the different circumscriptions of *Omphalina* by Singer and Bigelow. Virtually all the species recognized in Bigelow's 1970 monograph of *Omphalina* are included in Singer's expanded concept of *Gerronema* (Singer 1986), while Bigelow's concept of *Clitocybe* (Bigelow 1982a&b, 1985) encompassed any species left by Singer (1986) in *Omphalina.* In both classification systems, the primary distinction between the paired genera, either *Omphalina sensu* Singer and *Gerronema sensu* Singer or *Clitocybe sensu* Bigelow and *Omphalina sensu* Bigelow is pigment-based. Singer distinguishes *Omphalina* from *Gerronema* almost solely on the presence of fuscous, intraparietal or incrusting pigments, present in the former and absent in the latter. Bigelow's circumscripton of *Omphalina* revolves around the presence or suspected presence of carotenoids in all included species. Neither author analyzed pigments in the species each treated.

Pigmentation evidently either carried more weight than other taxonomic characters or appeared to be the strongest taxonomically important feature in the absence of other observed characters. However, *Gerronema sensu* Singer (1961a, 1964, 1975, 1986) is considered by many authors to be heterogeneous (i.e. Clémençon 1982, Moser 1983, Kuyper 1986), and several attempts have been made to reduce it to a more natural group. We agree *Gerronema sensu* Singer is heterogeneous and believe that *Omphalina sensu* Singer (1986) is also heterogeneous, but to a lesser extent. Lange's (1981. See also 1992) expansion of *Omphalina* to include *Gerronema, Haasiella,* *Rickenella,* and *Phaeotellus,* thus reflecting the historical basis of *Omphalina,* is appealing because of its simplicity, but clearly, it also represents a polyphyletic grouping.

In the case of *Omphalina sensu* Singer (1986), emphasizing pigmentation based primarily upon a generalized pathway leading to melanization (see Ellis & Griffith 1974; Hegnauer et al. 1985; Swan 1974) appears to us to result in an artificial classification. Notably, there are many genera in the Agaricales *sensu* Singer and in the Cantharellaceae that include species with more than one pigment group. In our opinion, dependence upon the presence or absence of especially common pigment groups, such as melanin, to define genera is perhaps unwise; in this case, pigmentation should be used judiciously or in conjunction with other taxonomic features. We believe that a combination of anatomical and biological characters clearly requiring a series of complex genetic expressions are of greater importance. Molecular analyses of DNA, such as that being conducted by Lutzoni and Vilgalys (1993), would be even more instructive.

The fact that the basic structural tissue forming the basidiomes of certain genera is sarcodimitic -- in contrast to monomitic, dimitic, or trimitic -- is of fundamental taxonomic importance, because the formation of sarcodimitic tissues is a complex series of processes requiring the expression of many genes. However, the extent to which sarcodimitic tissue formation can be used as an important taxonomic indicator of different evolutionary pathways lies somewhere between the extremes at the generic (i. e. *Trogia,* cf. Corner 1966, 1991) or family (i.e. Xerulaceae, cf. Redhead 1987) levels and schemes in which the presence of sarcodimitic tissue is not taken into account, ignored, or dismissed (Singer 1986, Reijnders 1993). Sarcodimitic tissue formation can be used to help define genera or generic groupings (Vilgalys & Rehner 1993).

Redhead (1986) restricted the genus *Gerronema* to species having sarcodimitic tissues. Subsequent confirmation of sarcodimitic construction in *G. melanomphax* Sing. (the type of the genus) was made by Redhead from an isotype (Singer T-1094 at MICH; Fig. 15). Species lacking sarcodimitic tissues and transferred to *Gerronema* after its inception are thereby excluded. By further delimiting the genus in this way, a more natural group is defined.

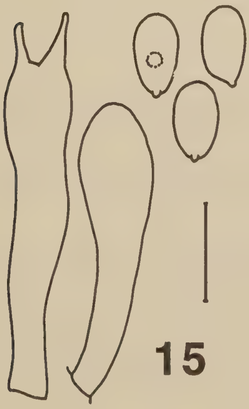

Fig. 15. *Gerronema melanomphax* (Isotype Singer T-1094 (MICH). Basidium, basidiole, and, basidiospores. Scale = 10 µm.

PSEUDOARMILLARIELLA **(Singer) Singer:** Bigelow (1982a) transferred *Agaricus ectypoides* Peck, the type for *Pseudoarmillariella,* to the genus *Omphalina.* By including *A. ectypoides* in *Omphalina,* he radically modified his 1970 concept of the genus which excluded species with amyloid spores. Although he did not so specify in published articles, Bigelow stated to Redhead in 1985 that he based this transfer upon the many similarities between *P. ectypoides* and *C. chrysophylla.*

The monotypic genus *Pseudoarmillariella* is characterized by the production of a thickened hymenium and subhymenium (Singer 1956). Its subhymenium is said to be "subirregularly intermixed-subramose, its elements short, strongly interlaced-curved in all directions and therefore at times appearing cellular (much like the subhymenium of *Cantharellula)"* (Singer 1986). *Pseudoarmillariella ectypoides* differs from all *Chrysomphalina* species by the production of incrusting pileal pigments, amyloid spores and the formation of clamp connections. This indicates a sufficient hiatus to recognize *Pseudoarmillariella* as distinct from *Chrysomphalina.*

HAASIELLA **Kotlaba & Pouzar:** *Haasiella venustissima* (Fr.) Kotl. & Pouzar (1966), the type of the genus, and *Chrysomphalina chrysophylla* were originally considered to be congeneric by Haas who invalidly proposed the genus *"Chrysomphalina* Haas" in 1962. Clemençon (1982a) excluded *H. venustissima* from *Chrysomphalina* Clç. when he validated the genus.

Like *Chrysomphalina* and *Cantharellus, Haasiella* possesses carotenoid pigments (Arpin & Fiasson 1971). However, it differs from *Chrysomphalina* by the formation of thick, metachromatic basidiospore walls (Kotlaba & Pouzar 1966) and a slightly gelatinized pileipellis (Kost 1986b). Both recognized species of *Haasiella* are distinctly terrestrial in contrast to the lignicolous *Chrysomphalina* species, and one, *H. splendidissima* Kotl. & Pouz., forms clamp connections.

Singer (1986) recognized *Haasiella,* but only as a section of *Gerronema.* However, since basidiomes of both species in his section are composed of monomitic tissues, the species are excluded from *Gerronema* in our classification. *Haasiella* is only known from Europe and was not treated by Bigelow (1970) in his North American monograph. Lange (1981) includes this genus in *Omphalina sensu lato.*

RICKENELLA **Raithelhüber:** Although not accepted in *Omphalina* by Bigelow, he questioned generic placement of the type species, *R. fibula* (Bull. : Fr.) Raithelh. (Bigelow 1970). *Rickenella* was distinguished from *Gerronema sensu lato* by Raithelhüber (1973) based on the presence of prominent characteristically shaped leptocystidia abundantly covering the pileus, stipe, and hymenial surface. These same features serve to distinguish *Rickenella* from *Omphalina. Rickenella* has been widely accepted by European and North American agaricologists (notably Kost 1984, Lamoure 1979) and we accept the genus as presently circumscribed.

All *Rickenella* species are small, omphalinoid, and bryophilous; the species are known to colonize either mosses or liverworts (Redhead 1981, Kost

1984) and pure isolates form distinctive slow-growing colonies (Lamoure 1979). This complex of features amply characterizes the genus. Additionally Kost (1984) has drawn attention to the physalomitic nature of the tramal tissues in this genus (physalomitic hyphae = conspicuously inflated hyphae deeply indented at the septa, see Clémençon 1982a).

Taxa now assigned to *Rickenella* have been placed into various genera by different authors attempting to create a natural classification. The two most common species, *R. fibula* (Bull.: Fr.) Raithelh. and *R. swartzii* (Fr.) Kuyp., were included in *Omphalina* at its inception (Quélet 1886), and Lange again accepted this generic placement in 1981. However, Kühner (1938), Smith (1947), and Bigelow (1970) included *Rickenella* species in the genus *Mycena*. In 1943 Singer treated them in his genus *Hemimycena*, but by 1951 he considered *Hemimycena* congeneric with *Marasmiellus,* including its cystidiate species in *Marasmiellus,* sect. *Fibulae.* Subsequently Singer (1961) transferred the species in section *Fibulae* to the genus *Gerronema*. When Singer (1962) resurrected *Hemimycena* as a distinct genus, he left section *Fibulae* in *Gerronema*. We recognize this section as the genus *Rickenella.*

***PHYTOCONIS* Bory de St. Vincent:** As circumscribed by Redhead & Kuyper (1987, 1988), *Phytoconis* is comprised of species previously treated in *Gerronema* and *Omphalina* (Singer 1986). *Phytoconis* was delimited primarily on the basis of lichenization and secondarily by the presence of a leptomitic hyphal system (used by Kuyper, 1986). Molecular analysis of the 25S rRNA gene of these lichenized species indicates that *Phytoconis* is a monophyletic genus linked to *Omphalina* (Lutzoni & Vilgalys 1993).

Notably, the genus includes both species with intracellular bright pigments and species with intraparietal and incrusting melanized pigments. The complex, unique, and characteristic nature of the fungal sheaths formed by these species (as detailed by Redhead & Kuyper, 1987) offers ample evidence of the close relationship among them. Additionally the subhymenium in *Phytoconis* species is loosely structured due to the elongated subhymenial cells and lack of clamp connections. In this regard *Phytoconis* differs from *Omphalina sensu stricto.*

***OMPHALINA* Quélet:** Although this generic name is central to the discussion of omphalinoid genera, its usage is the most controversial and unstable. A major problem lies in the typification of the name. The first lectotype was *Omphalina hydrogramma* (Fr.) Quél., selected by Earle (1909); however, this typification could be superseded by *O. umbellifera* (Fr.: Fr.) Quél. (proposed by Singer & Smith, 1946; Jørgensen & Ryman, 1989), by *O. epichysium* (Pers.: Fr.) Quél. (proposed by Redhead & Weresub, 1978; Redhead & Kuyper, 1993), or by *O. pyxidata* (Pers.: Fr.) Quél (submitted as an alternative by Redhead, 1993).

We have provisionally adopted *O. pyxidata* as type of the genus since it has to date received the strongest support in the Committee for Fungi and Lichens of the International Association for Plant Taxonomists. We restrict *Omphalina* to a primarily bryophilous group of species centered around *O. pyxidata.*

Omphalina species generally lack distinctive hymenial cystidia and highly differentiated cuticles (but exceptionally can have cystidioid end cells or scales, *i.e. O. sphagnicola* (Berk.) Moser). Omphalinas have smooth, thin-walled, inamyloid spores. Anatomically *Omphalina* differs from both *Chrysomphalina* and *Phytoconis* by the relatively narrow, compact subhymenium composed of short basidia-bearing cells; this tissue, which binds the hymenium more tightly than does the subhymenium of *Phytoconis*, is best observed in squash mounts. Therefore, basidia and basidioles in *Phytoconis* species tend to spread out relatively easily while those of *Omphalina* tend to spread out in rafts or sections of hymenium. We include in *Omphalina* several species groups largely separated by differences in pigmentation. We do not restrict the genus to species with darkly melanized incrustations or intraparietal pigments as does Singer (1986). Examples of differently pigmented species are: *O. postii* (Fr.) Singer (orangish intraparietal pigments), *O. viridis* (Hornem.) Kuyper (blue-green/blackish incrusting pigments), *O. pyxidata* (brownish incrusting pigment) and ***Omphalina hohensis* (Smith) *comb. nov.**** (greyish black incrusting pigments) *Basionym = *Omphalia hohensis* A.H. Smith, Contr. Univ. Mich. Herb. 5: 27. 1941. Delimitation from *Arrhenia* Fries (including *Phaeotellus* Kühner & Lamoure and *Leptoglossum* Karst. cf. Redhead 1984) is open to reevaluation using molecular analysis.

DISPOSITION OF *OMPHALINA SENSU* BIGELOW 1970

Most of the twelve species and one variety Bigelow (1970) included in *Omphalina* are placed elsewhere following the generic classification for omphalinoid agarics outlined above.

As discussed in Part 1, five taxa belong in *Chrysomphalina*: *O. chrysophylla* (Fr.) Murrill var. *chrysophylla* = *C. chrysophylla* var. *chrysophylla, O. chrysophylla* var. *salmonispora* = *C. chrysophylla* var. *salmonispora, O. hoffmanii* = *C. chrysophylla* var. *hoffmanii, O. luteicolor* Murrill = *C. aurantiaca* (Redhead 1986), and *O. wynniae* = *C. grossula.*

Four other species were transferred to *Phytoconis* by Redhead & Kuyper (1987, 1988): *O. ericetorum* = *P. ericetorum, O. luteovitellina* (Pilát. & Nannf.) M.Lange = *P. luteovitellina, O. hudsoniana* (Jenn.) Bigelow = *P. viridis,* and *O. sphagnophila* (Peck) Bigelow = *P. ericetorum.*

Omphalina subclavata (Peck) Murr. is now *Gerronema subclavatum* (Peck) Redhead (Redhead 1986).

Of the remaining three species treated by Bigelow, *Omphalina postii* (Fr.) Sing. remains in the genus *Omphalina.* We do not consider the tissues in the stipes of *O. postii* or the related species ***Omphalina marchantiae*(Sing. & Clç.) comb. nov.** (Basionym = *Gerronema marchantiae* Sing. & Clç. Schweiz. Zeitschr. Pilzk. 49: 118. 1971.) to be sarcodimitic as suggested by Senn-Irlet et al. (1990). *Omphalina marchantiae* has been reported from Alaska (Laursen & Ammirati 1982, Laursen & Chmielewski 1982) and British Columbia (Kroeger 1989) in North America since Bigelow's 1970 monograph.

Two species of *Omphalina sensu* Bigelow -- *O. occidentalis* (A.H.Sm.) Big. and *O. olivaria* (Peck) Sing. -- remain, both of uncertain status.

When Smith (1941) first described *Omphalia occidentalis,* he compared it with both *Mycena* and *Hygrophorus,* noting its ambiguous taxonomic affinities. Bigelow (1970) also felt that *O. occidentalis* was poorly delimited from *Hygrocybe* and arbritrarily retained it in *Omphalina.* It appears to us that this species may be closely allied to species such as *Hygrocybe parvula* (Peck) Murr. and *Hygrophorus* (section *Hygrocybe) mycenoides* A.H.Sm. & Hesl., both of which have small yellow basidiomes with length:width basidia ratios that overlap those for *O. occidentalis* (cf. Hesler & Smith 1963). The presence of clamp connections and a thin ixocutis in *O. occidentalis*, both present in *H. parvula* and *H. mycenoides,* are features more consistent with *Hygrocybe* than with the omphalinoid genera. Bas (1988) noted that strict application of length-width ratios does not apply for many *Hygrocybe* species, and reliance must be made on other features such as bright colors and viscid pileal surfaces, features particularly evident in *O. occidentalis.* Thus, we propose the name ***Hygrocybe luteo-omphaloides nom. nov.**** for this fungus. *Basionym = *Omphalia occidentalis* A.H. Smith, Contr. Univ. Mich. Herb. 5: 28. 1941 ***nec*** *Hygrocybe occidentalis* (Dennis) Pegler *in* Pegler & Fiard, Kew Bull. 32(2):310. 1978. ***nec*** *Hygrophorus occidentalis* Sm. & Hesl. Lloydia 2:18. 1939

The type of *Omphalina olivaria* possesses incrusting pigments in the pileipellis and may in fact be a small *Clitocybe* as suggested by Bigelow (1970). It is known only from the type collected over 100 years ago from a burn in New York State. The name is retained in *Omphalina* on the assumption it was associated with pyrophilous mosses. Bigelow (1970) has already recorded the fact that other reports of *O. olivaria* are based on misdeterminations.

KEY TO SELECTED OMPHALINOID GENERA

1. Cystidia present, densely and evenly distributed over pileipellis, hymenial surfaces, and stipitipellis, visible under a hand lens as small hyaline hairs, usually capitate, not fasciculate *[bryophilous, lacking incrusting pigments, spores inamyloid and thin-walled]* ....***Rickenella***

1. Cystidia lacking in most species; if present, more limited in distribution, often inconspicuous or poorly differentiated, not capitate, sometimes fasciculate in small squamules *[other features variable]* **2**

2. Spores amyloid *[both incrusting pigments and non-incrusting pigments present simultaneously, lamellar trama complex with thick dense lateral subhymenial zones, hymenium thickening and basidia of different lengths, lignicolous]*..***Pseudoarmillariella***

2. Spores inamyloid *[other features variable]*...**3**

3. Context of pileus and/or stipe composed of typical sarcodimitic tissues *[spores thin-walled, lignicolous, (primarily found in sub-tropical/tropical regions)]*... ***Gerronema***

3. Context of neither stipe nor pileus composed of sarcodimitic tissues *[other features variable]*... **4**

4. Spore walls conspicuously thickened and metachromatic in cresyl blue *[basidiomes orange, possessing carotenoids, terrestrial. EXTRALIMITAL -- European]*... ***Haasiella***

4. Spore walls thin, not metachromatic *[other features variable]*.............. **5**

5. Thalli lichenized, composed of minute sphaerules or squamules while superficially appearing to be terrestrial, bryophilous or lignicolous; walls of hyphae which connect sphaerules or irregular granules and basal mycelium noticeably thickened from slight to > 0.5 um *[clamp connections lacking, context of basidiomes leptomitic, subhymenial layer a loose structure not forming a sealed compact membrane]* ...... ***Phytoconis***

5. Thalli not lichenized, typically mycelial and mostly embedded in substrate (terrestrial, bryophilous, lignicolous); walls of basal mycelium not thickened *[other features variable]* **6**

6. Basidia of +/- conspicuously unequal lengths with the subhymenium +/- developing into a pachypodium, hymenium thickening with age *[basidiomes brightly coloured by carotenoids (yellow, orange, yellow mixed with green), lignicolous, clamps lacking]* .... ***Chrysomphalina***

6. Basidia more or less terminating at the same level, subhymenium a thin layer; hymenium not thickening in age *[other features variable]*... **7**

7. Basidiomes brightly pigmented and pileipellis gelatinized to subgelatinized with a thin but distinct cutis *[pileus minute, clamp connections present, bryophilous]*... ***Hygrocybe luteo-omphaloides***

7. Basidiomes not both brightly pigmented and with a gelatinized pileipellis *[other features variable]* **8**

8. Bryophilous or phycophilous (sometimes appearing terrestrial or lignicolous due to sparse growth of associated algae or bryophytes), never on sound clean wood or conspicuously causing white or brown wood rots *[with incrusting or intraparietal pigments, odor never farinaceous, subhymenium a compact dense thin layer totally sealing in the lamellar trama from the hymenium]*........................ ***Omphalina***

{A completely pigmentless species associated with algal films on silty soil is *Hemimycena ignobilis* (Josserand) Singer, of debatable generic disposition}

8. Terrestrial or lignicolous, not dependent on living algae or bryophytes; if on wood mycelium clearly penetrating and decaying wood *[easily cultured on standard general media from spores, odor sometimes farinaceous, many species large and not omphalinoid]*..........***Clitocybe***

GENERIC CIRCUMSCRIPTIONS

CHRYSOMPHALINA Clç.

Basidiomes fleshy, pileus convex, usually umbilicate; lamellae decurrent, occasionally forking; stipe central and cartilaginous to fleshy; spores white to slightly pigmented in mass, lacking a germ pore, walls thin, smooth, inamyloid, hyaline, and not metachromatic in Cresyl Blue.

Pileipellis relatively undifferentiated from the monomitic tramal tissues, often with projecting loose undifferentiated hyphal ends +/- aggregated into small scales; often containing intracellular darkish pigments in addition to cytoplasmic carotenoids in the tissues; tramal hyphae thin- to somewhat thick-walled, inamyloid, nongelatinized, without clamp connections; hymenophoral trama bidirectional; hymenium thickening, basidia in older specimens conspicuously varying in length, subhymenium a thick layer forming a dense band of tissue in age; lacking hymenial cystidia; sometimes with scattered relatively undifferentiated cystidioid elements on the stipe

Lignicolous.

Type species: *C. chrysophylla* (Fr.) Clç

GERRONEMA Sing.

Basidiomes membranous to elastic, pileus convex to infundibuliform or umbilicate; lamellae decurrent; stipe central, elastic to fleshy or cartilaginous; spores white in mass, lacking a germ pore, walls thin, smooth, inamyloid, hyaline, and not metachromatic in Cresyl Blue.

Pileipellis poorly differentiated, monomitic, often with intracellular pigments differing from those in the trama or hymenium, occasionally with scattered cystidioid elements on the disc; tramal tissue sarcodimitic (hyphae basically of two types: elongated fusoid cells bonded by filamentous branched hyphae, most easily observed in the stipe), inamyloid, +/- gelatinized, and lacking dark intraparietal or incrusting pigments, with or without clamp connections; hymenophoral trama sarcodimitic; hymenium not conspicuously thickening.

Lignicolous.

Type species: *G. melanomphax* Sing.

HAASIELLA Kotl. & Pouz.

Basidiomes fleshy, pileus convex, slightly umbilicate; lamellae decurrent, cantharelloid; stipe central and somewhat cartilaginous; spores yellow to salmon rose in mass, lacking a germ pore, walls thickened (double walls present), smooth, inamyloid, hyaline, red metachromatic in Cresyl Blue.

Pileipellis a layer of gelatinized, leptomitic hyphae often with swollen hyphal ends; containing intracellular carotenoid pigments in the tissues; tramal hyphae thin- to somewhat thick-walled, inamyloid, +/- gelatinized, with or without clamp connections; hymenophoral trama irregular, possibly bidirectional; subhymenium continually producing basidia; hymenium thickening; lacking hymenial cystidia.

Terrestrial.

Type species: *H. venustissima* (Fr.) Kotl. & Pouz.

OMPHALINA Quél.

Basidiomes membranous to fleshy, pileus convex to infundibuliform or umbilicate; lamellae decurrent, regular to cantharelloid; stipe central to eccentric but not lateral, cartilaginous, most often glabrous; spores white in mass, lacking a germ pore, walls thin, smooth, inamyloid, hyaline, and not metachromatic in Cresyl Blue.

Pileipellis relatively undifferentiated from the monomitic tramal tissue in most species, sometimes with aggregated hyphal ends forming small scales usually restricted to the pileal disc, rarely abundant enough to form an interrupted turf of fasciculate cystidioid elements; often pigmented with dark or brightly colored intraparietal, incrusting, or intracellular pigments; tramal hyphae thin-walled, inamyloid, nongelatinized, usually with but some species without clamp connections; hymenophoral trama bidirectional to irregular; basidia not varying in length; hymenium not appreciably thickening; subhymenium a relatively thin, compact dense layer; poorly differentiated hymenial cystidia present in at least one species concentrated near the lamellar edge; caulocystidia, when present, generally poorly differentiated and ranging from sparse to aggregated in small squamules.

Either bryophilous or lignicolous.

Type species: *O. pyxidata* (Pers: Fr.) Quél. subject to conservation.

PHYTOCONIS Bory

Basidiomes fleshy to membranous, pileus convex, usually umbilicate; lamellae decurrent; stipe central, cartilaginous to tough, usually pubescent; spores white in mass, lacking germ pore, walls thin, smooth, inamyloid, hyaline, and not metachromatic in Cresyl Blue.

Pileipellis relatively undifferentiated from the leptomitic tramal tissue; hyphae thin to somewhat thickened, inamyloid, nongelatinized, with either fuscous intraparietal pigments or brightly colored intrahyphal pigments; without clamp connections; hymenophoral trama sub-irregular; basidia in older specimens varying in length; hymenium usually slightly thickening with a loose subhymenial structure; lacking cystidia on the pileus and in the hymenium; frequently with cystidioid or hair-like hyphal ends on the stipe.

Lichenized, characterized by thalli totally enveloping *Coccomyxa* algal cells in non-perforated sheaths of polygon-shaped cells, forming either scattered sphaerules or irregular granules typically less than 1 mm in diameter or flattened/lobed thalli typically less than 1 cm in diameter connected by filamentous hyphae.

On soils, mosses, peat, or decayed conifer wood.

Type species: *P. botryoides* (L.) Bory = *P. ericetorum* (Fr.) Redhead & Kuyper.

PSEUDOARMILLARIELLA Sing.

Basidiomes fleshy, pileus convex, usually umbilicate; lamellae decurrent, often forked; stipe central and cartilaginous to fleshy; spores white to slightly pigmented in mass, lacking a germ pore, walls thin, smooth, amyloid, hyaline, and not metachromatic in Cresyl Blue.

Pileipellis relatively undifferentiated from the monomitic tramal tissues; with incrusting pigments and non-incrusting cytoplasmic pigments simultaneously present; tramal hyphae inamyloid, +/- gelatinized, thin- to somewhat thick-walled, with clamp connections; hymenophoral trama subirregular; hymenium thickening, basidia in older specimens conspicuously varying in length, subhymenium a dense layer with short, intermixed subramose, strongly interlaced elements, curved in all directions; lacking hymenial cystidia; stipe densely covered with thin-walled hair-like hyphal ends.

Lignicolous.

Type species: *P. ectypoides* (Peck) Sing.

RICKENELLA Raithelh.

Basidiomes fleshy, pileus convex, usually umbilicate; lamellae decurrent; stipe central and cartilaginous; spores white in mass, lacking a germ pore, walls thin, smooth, inamyloid, hyaline, and not metachromatic in Cresyl Blue.

Pileipellis relatively undifferentiated from the physalomitic tramal tissue; hyphae thin-walled, inamyloid, nongelatinized, and lacking dark intraparietal or incrusting pigments, with or without clamp connections; hymenophoral trama regular; hymenium not thickening; characterized by abundant capitate to non-capitate refractive-walled evenly scattered leptocystidia on the pileus, hymenial surfaces, and stipe.

Bryophilous.

Type species: *R. fibula* (Bull.: Fr.) Raithelh.

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ALTERNARIA THEMES AND VARIATIONS (106–111)

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ABSTRACT

This paper reviews *Alternaria infectoria* and compares with it *A. triticimaculans* Simmons & Perelló, sp. nov. (on *Triticum aestivum*, Argentina), *A. oregonensis* Simmons, sp. nov. (on *T. aestivum*, Oregon, U.S.A.), and *A. metachromatica* Simmons, sp. nov. (on *T. aestivum*, Australia), all members of the *A. infectoria* species group. *A. triticina* and *A. triticicola*, both from *T. aestivum*, India, are reviewed for contrast and clarification of taxonomic relationships in *Alternaria*.

XIV. SOME *ALTERNARIA* TAXA ON *TRITICUM*

Introduction

The receipt of *Alternaria* specimens related to a leaf-spot disease of wheat currently under study in Argentina and a need for identification of the pathogen have required a return to consideration of taxa similar to *A. infectoria* Simmons (Simmons 1986). The phrase "*Alternaria infectoria* complex" is used here as a grouping term for relatively small-spored *Alternaria* taxa that are distinguished as much by the prominence of their secondary conidiophore structure as they are by the morphology of their conidia.

In the absence of their ascosporic teleomorphs, the *Alternaria* taxa of this species complex are recognized in culture primarily as loose to dense clumps of geniculate and branching primary and secondary conidiophores with spore chains whose conidial elements are separated by sturdy, often elongate, readily distinguishable pseudorostrate connectives. The nature of this sporulation pattern recently has been discussed and contrasted in detail with other kinds of *Alternaria* sporulation patterns (Simmons and Roberts 1993).

The *A. infectoria* complex currently comprises three named *Alternaria* species, all known as isolates derived directly from ascospores of their teleomorphs: *A. conjuncta* Simmons known at present from *Pastinaca* and *Plantago*; *A. infectoria*, from *Elymus*, *Festuca*, *Lolium* and *Triticum*; and *A. ethzedia* Simmons, from *Brassica*. The distinctive sporulation pattern, which is determined by the strongly pseudorostrate nature of many of the conidia, is seen very frequently among isolates of relatively small-spored taxa from numerous substrates, sometimes as infecting agents but also probably as saprophytes, and apparently without climate zone restriction. All named species known until now for the complex are anamorphs of *Lewia* Barr & Simmons (Simmons 1986).

Sorting out this entire group on the basis of cultures is not high on my priority list, for members of the *A. infectoria* complex, even when culturally quite stable and segregatable into recognizable taxa when studied side-by-side, are highly resistant to verbal disaggregation. An additional deterent resides in the fact that field material rarely accompanies derivative cultures, so it is nearly impossible to link modern isolates with any of the multitude of field-based, potentially usable types and names in the literature. It presumably will require an epiphytotic or industrial need of significant proportions to divert molecular study to such classification problems. However, I think that such an approach eventually will be needed in sorting out the taxa of this and other complexes of small-spored *Alternaria* species.

The isolates from wheat in Argentina, mentioned above, are supported by excellent sporulating field material. They need identification; isolates of a similar taxon from wheat in Oregon deserve attention; and another similar isolate, from wheat in Australia, unique in its blue conidia that turn pink in lactic acid, invites comparison and comment. All three of these taxa have characteristics of the *A. infectoria* species complex and are discussed here in comparison with typical *A. infectoria*. Two other very distinctive *Alternaria* species, *A. triticina* Prasada & Prabhu (1963) and *A. triticicola* V. G. Rao (1964), originally described from wheat but considered not to be morphological members of the *A. infectoria* complex, are included here for purposes of contrast and of guidance in identification of these *Triticum* inhabitants.

Conventions used in this discussion include: herbarium and culture collection abbreviations are from Holmgren et al. (1990), given here in boldface type; references to my records of material studied are in record volume-page format, e.g., EGS 27-193; a contraction "Alt.T&V" is used to simplify reference to this series of papers on *Alternaria*, usually with a number specifying a pertinent unit in the series (Simmons 1981-1993, all in *Mycotaxon* volumes of the period); routine culture conditions include PCA, Hay, and V-8 agars (Simmons and Roberts 1993, p. 136) in plastic Y-plates at ca. 22C under a 10/14hr, cool-white fluorescent light/dark cycle; microscopic details of material mounted in lactic acid are recorded from observations made at 195X and 780X.

106. **Alternaria infectoria** Simmons (1986) Fig. 84

Cultures ex type of *A. infectoria* (EGS 27-193; Alt.T&V 23, Simmons 1986) sporulate abundantly as rather open, bushy clumps of geniculate and branching secondary conidiophores produced by and separated by secondary conidia. The simplest form of branching complex originates from the pseudorostrate tip of a single primary conidium borne at the tip of a simple primary conidiophore. The initial (i.e., primary) conidiophore may remain simple or it may become elongate and variously geniculate at several successive conidiogenous loci, yielding a fairly dense clump of simple sporulation structures. It may arise directly from the agar surface or originate as a morphologically distinct branch of an aerial hypha.

Individual sporulation clumps of typical *A. infectoria*, when viewed at 50X, appear relatively open and fragile due to the rather narrow dimensions of the conidia and the dominating framework of secondary conidiophores, in contrast to the visibly more robust character of these structures in the Argentina wheat isolate (Alt.T&V 107).

Elements of Fig. 84 emphasize the appearance of the secondary conidiophores, which can be of any length up to ca. 125 µm. The secondary conidiophore that developes directly from the first-formed conidium usually is much longer than ones produced later in the branching system, often equalling at least half the height of its sporulation clump. The low-magnification drawings illustrate sizes of conidia and conidiophores as they develop in young clumps or in major branches of more complex ones.

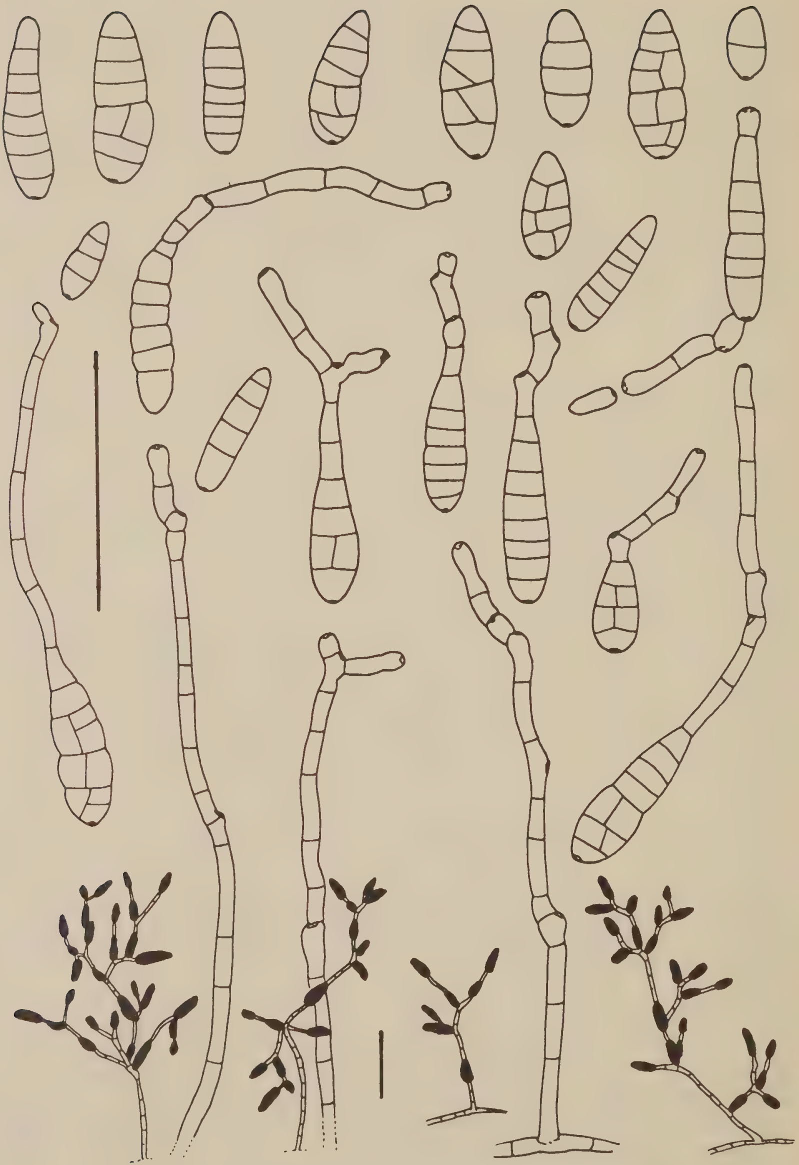

Fig. 84. *Alternaria infectoria*: sporulation habit (conidium bodies opaque, conidiophores clear; line = 50 μm); primary conidiophores, conidia with secondary conidiophores, and terminal conidia (line = 50 μm); from ex-type culture on PCA.

All chain formation in *Alternaria* depends on an alternation of conidia and secondary conidiophores (pseudorostra). The pattern of prominent secondary conidiophore elaboration and interspersed conidia is a conspicuous character of the *A. infectoria* group, and this readily observed arrangement is being used here in an attempt to segregate this group from among numerous somewhat similar taxa for systematic purposes. In contrast, for example, relatively inconspicuous secondary conidiophores (tending toward 1-2 short cells) are the norm in the similarly bushy sporulation clumps typical of the *A. alternata* complex of species.

107. **Alternaria triticimaculans** Simmons & Perelló, sp. nov.
Fig. 85 & 86

Etym.: L., *triticum*, wheat + *maculans*, spotting

Ex culturis in agaro PCA descripta. Coloniae mycelio epiagaro laxe lanoso vel araneoso copiose conidiogenae. Sporulatio in catenis ramosis conidiorum 30-40++ aggregata. Conidiophora elongata, ramosa, geniculata, ca. 130+ x 3-4 µm. Conidia ovoidea vel longiovoidea vel ellipsoidea, ad 40-45 x 9-11 µm, erostrata, longipseudorostratescentia, sublevia vel aspera, sordide fulva, 6-7 transverse et parce longitudine septata. Habitatio typi in folio Triticum aestivum L., La Plata, Argentina. Holotypus: pars ex cultura EGS 41-050 (EGS isol. ex specimine A. Perelló leg., 23-II-1993 misso) desiccata et in BPI conservata.

Spore samples from leaf surfaces contain numerous well-developed, beakless, long-ovoid and long-ellipsoid conidia along with roughly equal numbers of similar conidia that have developed an apical secondary conidiophore about half as long as the spore body. Beakless conidia have a hemispheric or short conical apical cell. Conidia that may appear to have a gradually narrowing beak are, in fact, in the process of generating a pseudorostrum. The site of change from body to beak usually can be seen as a slight break in wall contour, color, and ornamentation. Beakless conidia and conidium bodies reach a size range of ca. 30-60 x 11-14 µm and are a dilute dull yellowish brown, smooth to moderately rough, and 5-10 transeptate with 1-2 longisepta in 3-6 of the transverse segments. The approximately equal percentages of beakless and pseudorostrate conidia might lead to inference that this is a taxon that is limited to production of short chains of 2-3 conidia in nature. Perhaps; but I consider it more likely that restricted sporulation on the field specimens I have

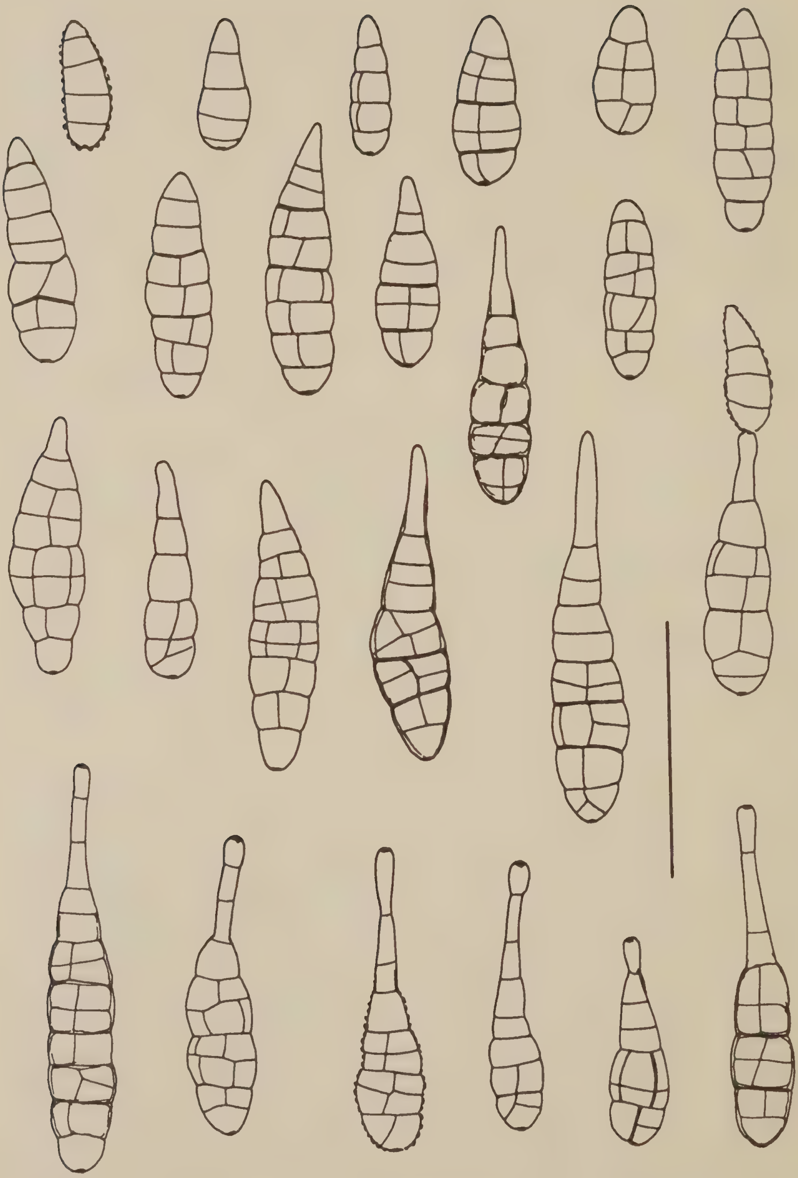

Fig. 85. *Alternaria triticimaculans*: conidia from field specimen source of holotype (line = 50 μm).

seen was governed by ecological factors (humidity, temperature, light) that permitted only one or two spurts of sporulation before conditions changed. In any case it is an observation worth recording, for the sporulation pattern itself, though not conidium morphology, is much different in culture than has been seen in nature.

Typical conidia from the host surface germinate readily and, within 2-4d under my routine conditions, yield abundantly sporulating colonies on PCA, Hay, and V-8 agars.

Young colonies (5-7d) in PCA plates are loosely lanose to arachnoid. They have very abundant sporulation from conidiophores that originate at the agar surface or from aerial hyphae. Primary conidiophores are simple with a single apical conidiogenous locus, commonly ca. 75 x 3 μm; or they may become longer (130 μm or more), variously branched, and successively geniculate at a few conidiogenous loci. First-formed conidia tend to be narrowly elliptical or ovoid and erostrate until production of apical secondary conidiophores begins. Primary conidia are ca. 40-45 x 9-11 μm, almost smooth to visibly but not heavily ornamented, dilute dull yellowish brown, with 6-7 transepta and either no longisepta or only 1 in 1-3 of the transverse divisions. A solitary elongating secondary conidiophore usually develops from each primary conidium apex. However, it is not uncommon in this taxon for a group of 2-3 subparallel pseudorostra to have a common base cell or for a pair of pseudorostrum branches to originate in a spreading dichotomous manner just below a terminal conidiogenous locus.

Sporulation clumps have much the same pattern of seemingly unlimited complexity as that seen in *A. infectoria*, with series of secondary conidia separated by pseudorostra of various lengths and numbers of geniculations (conidiogenous loci). The open, bushy aspect of sporulation clumps in *A. triticimaculans*, as with that of *A. infectoria*, depends almost entirely on pseudorostrum branching and bending. Only rarely does a conidium itself generate a branch by producing a lateral or basal conidiophore. Single sporulation clumps commonly have 30-40++ conidia. Secondary conidia are similar to primary conidia in size, color, septation, and ornamentation; both types are smaller than fully developed conidia found on the natural substrate.

Sporulation clumps of *A. triticimaculans* appear (at 50X) more robust and more strongly branched than do those of *A. infectoria*. This appearance derives from the overall

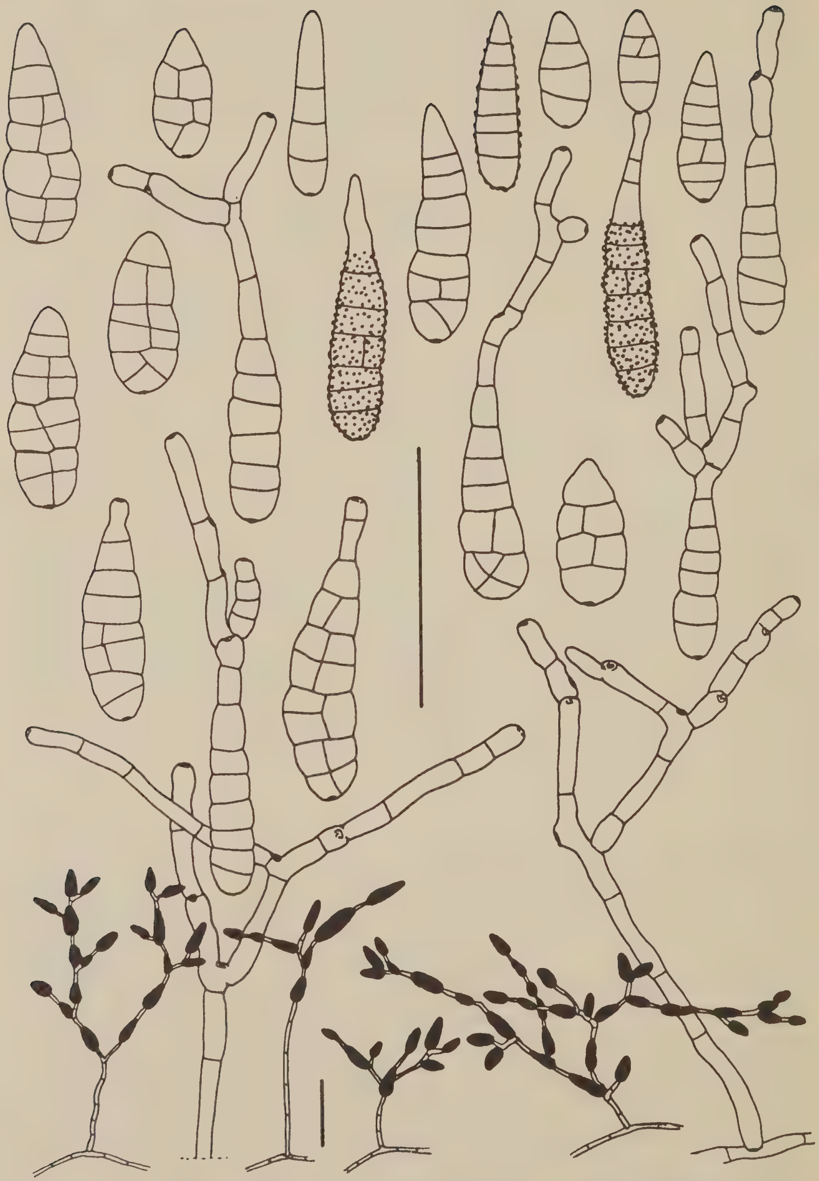

Fig. 86. *Alternaria triticimaculans*: sporulation habit (conidium bodies opaque, conidiophores clear; line = 50 μm); primary conidiophores, conidia with secondary conidiophores, terminal conidia (line = 50 μm); from ex-type culture on PCA.

greater size of conidia and more conspicuous secondary conidiophores of *A. triticimaculans* as compared with those of *A. infectoria*.

Natural growths of *A. triticimaculans* are known at present only from specimens on infected wheat leaves that originated with Analía Perelló, Universidad Nacional de La Plata, La Plata, Bs. As., Argentina. Several 1-conidium isolates were obtained from one such specimen; one of these, EGS 41-050, has been used in these comparisons and is cited in dried form as holotype of the species.

108. **Alternaria oregonensis** Simmons, sp. nov. Fig. 87

Ex culturis in agaro PCA descripta. Coloniae mycelio epiagaro vel aerie araneoso dense conidiogenae. Sporulatio in catenis ramosis conidiorum 100+ aggregata. Conidiophora primigena elongata, geniculata, ca. 100-150 x 3-4 µm; conidiophora secundaria geniculata, ca. 20-60 x 3 µm. Conidia primigena plerumque longe ellipsoidea, ca. 35-60 x 10-15 µm, 7-11 transverse septata et 1-4 longitudine septata, dilute sordide fulva, pseudorostratescentia; conidia secundaria ovoidea, obconica vel ellipsoidea, ca. 23-33 x 8-14 µm, levia vel conspicue aspera, sordide fulva, 5-7 transeptata et parce longiseptata. Habitatio typi in folio Triticum aestivum L., Oregon, U.S.A. Holotypus: pars ex cultura EGS 29-194 desiccata et in BPI conservata.

Colonies 5-7 days old on PCA sporulate abundantly in dense, often crowded, bushy clumps directly on the agar surface or in more open clumps on loosely arachnoid aerial mycelium, essentially all of which is conidiophorogenous. Aerial clumps derived from a single primary conidiophore may consist of a few to a few dozen conidia. Surface clumps commonly sporulate so abundantly that an estimate of 100+ conidia per clump is reasonable.

Primary conidiophores 100-150 x 3-4 µm readily become geniculate at 1-5+ successive conidiogenous loci. First-formed conidia are predominantly long-ellipsoid, although some short-ovoid primary conidia also are present. Conidium bodies tend to be in a size range of ca. 35-60 x 10-15 µm when apical secondary conidiophores are produced. Such conidia have 7-11 transepta and usually 1 longiseptum in each of 1-4 of the transverse segments; 3-4 of the earliest-formed transepta and major longisepta become slightly thicker and darker than younger septa. Secondary conidiophores become geniculate and conidiogenous at 1-4+ loci; or occasionally they develop in pairs from the apical cell of a conidium or arise laterally from the basal cell. They are 20-60 x 3 μm, longest on conidia at or near the base of a sporulation clump and usually shorter, even only 1-2-celled, in the distal portions of the branching chains. Beakless terminal conidia in a well-developed clump are ovoid, obconical or ellipsoid. Secondary conidia are ca. 23-33 x 8-14 μm, smooth to conspicuously rough, dilute to slightly darker dull yellowish brown, with 5-7 transepta and usually one longiseptum in 1-5 of the transverse segments.

Surface sporulation clumps in *A. oregonensis* cultures on PCA originate in long, narrow, abundantly transeptate primary and early secondary conidia, which generate chains of large numbers of relatively small, short-beaked conidia, resulting in dense bushy clumps. In comparison, surface clumps of *A. triticimaculans* originate in shorter, narrow primary conidia with fewer and less heavily pigmented septa; these conidia generate an open, branching system of pseudorostrate and beakless conidia which in general are comparatively large and robust when fully developed. Sporulation clumps of *A. infectoria*, in contrast, are open and almost delicate in appearance due to the dominance of long narrow secondary conidiophores and the abundance of relatively small secondary conidia. The sporulation mass, composed of thousands of individual clumps, is dense and, to the unaided eye, dull black in PCA cultures of each of the three taxa.

The isolate (EGS 29-194) upon which this discussion of *A. oregonensis* and its dried-culture holotype are based originated in the laboratory of C. L. Leach, Oregon State University, Corvallis. The source was a leafspot of wheat noted in the spring of 1970. Positive pathogenicity was demonstrated at that time by R. L. Powelson (personal communication), who sent additional isolates of the taxon from leafspot of wheat in Oregon in 1972.

109. **Alternaria metachromatica** Simmons, sp. nov. Fig. 88

Etym.: Gr. *meta-*, change; *chromatikos*, of color

Ex culturis in agaro PCA descripta. Coloniae mycelio epiagaro vel aerie araneoso copiose conidiogenae, griseocaeruleae, fuscantes. Sporulatio in catenis ramosis conidiorum multorum aggregata. Conidiophora primigena simplicia;

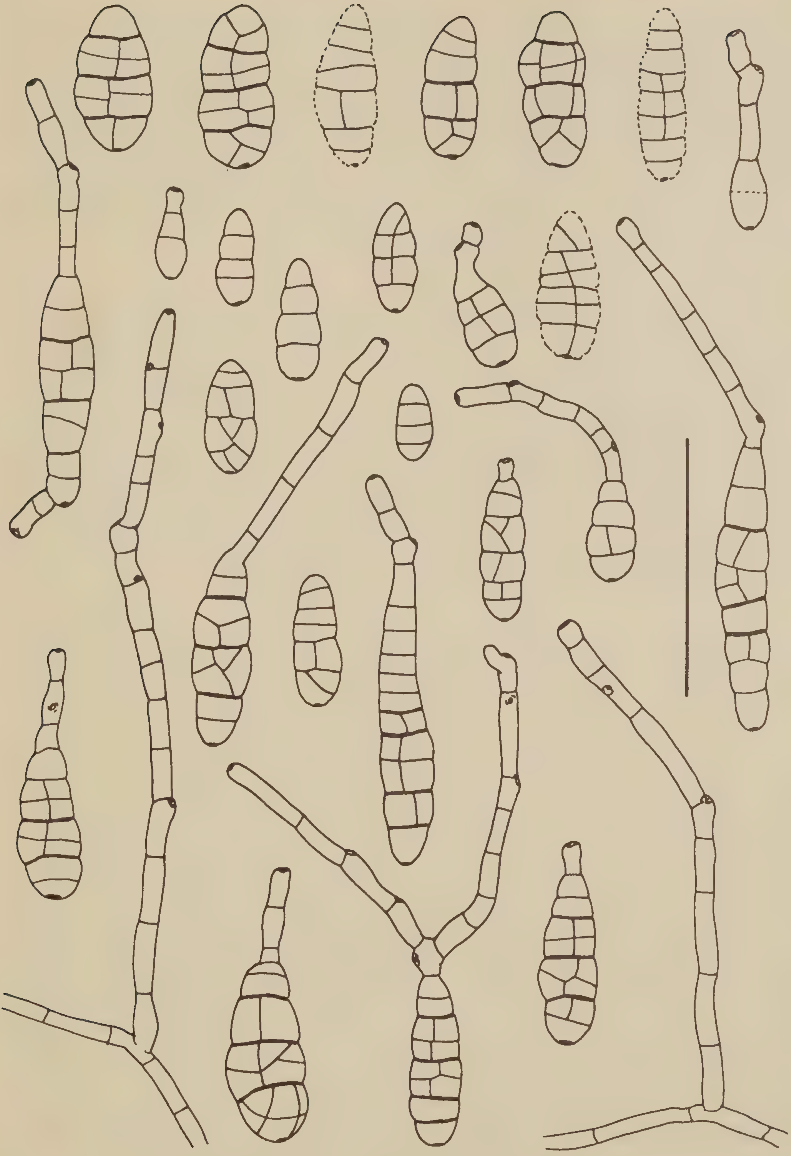

Fig. 87. *Alternaria oregonensis*: primary conidiophores, conidia with secondary conidiophores, and terminal conidia (line = 50 μm); from ex-type culture on PCA.

secundaria geniculata, 1-4 conidiogena, 25-40 µm longa. Conidia primigena et secundaria ovoidea vel ellipsoidea, distincte scabra, 3-5 transverse et 0-1 longitudine septata, pseudorostrata. Conidia tertiaria et in catenis sequentibus ovoidea vel sphaerica, 0-3 transeptata, brevipseudorostrata vel erostrata, scabra. Conidia, conidiophora et hyphae aeriae dilute caeruleae in aqua, rosae in acido lactico. Habitatio typi in semine Triticum aestivum L., South Australia, Australia. Holotypus: pars ex cultura EGS 38-132 desiccata et in BPI conservata.

Colonies 3-5 days old on PCA sporulate abundantly in dense bushy clumps directly on the agar surface and in more open but eventually dense clumps on loosely arachnoid aerial mycelium, essentially all of which is conidiophorogenous. Young sporulating colonies viewed in either incident or transmitted light have a definite blue color, near Light Sky Blue and Sky Grey (Ridgway 1912). The color becomes darker and duller as the colony ages to 8-10 days. Surface clumps and aging aerial clumps are so abundantly sporogenous in a compact bush of branching chains that an estimate of several hundred conidia per clump can be made.

Primary conidiophores tend to be simple or meagerly branched, not abundantly or conspicuously elongate and multigeniculate. First-formed conidia are ovoid or ellipsoid with distinctly rough outer walls, 3-5 transepta and no longisepta or at most one in 1-2 of the transverse segments, ca. 25-35 x 5-10 µm. Primary conidia and a small percentage of secondary conidia in developing chains produce relatively long apical secondary conidiophores ca. 25-40 µm long. Secondary conidiophores often develop as strongly geniculate branches that are conidiogenous at 1-4+ loci. Primary and secondary conidia of *A. metachromatica* produce relatively long pseudorostra during early development of chains and, therefore, can be considered along with other taxa of the *A. infectoria* species group. However, subsequent distal sporulation in chains is so rapid that most conidia do not develop beyond a stage of 1 or 2 to 4 cells, rarely have a longitudinal septum, and have only a short 1-celled pseudorostrum or simply a morphologically erostrate but conidiogenous apex. Conidia in the distal half of chains are ca. 4-18 x 4-8 µm. Most conidia have slightly to heavily ornamented walls. Conidia, conidiophores, and aerial hyphae remain blue when mounted in water. They turn pink instantly when mounted in lactic acid. The color appears to be concentrated in the walls and septa of conidia.

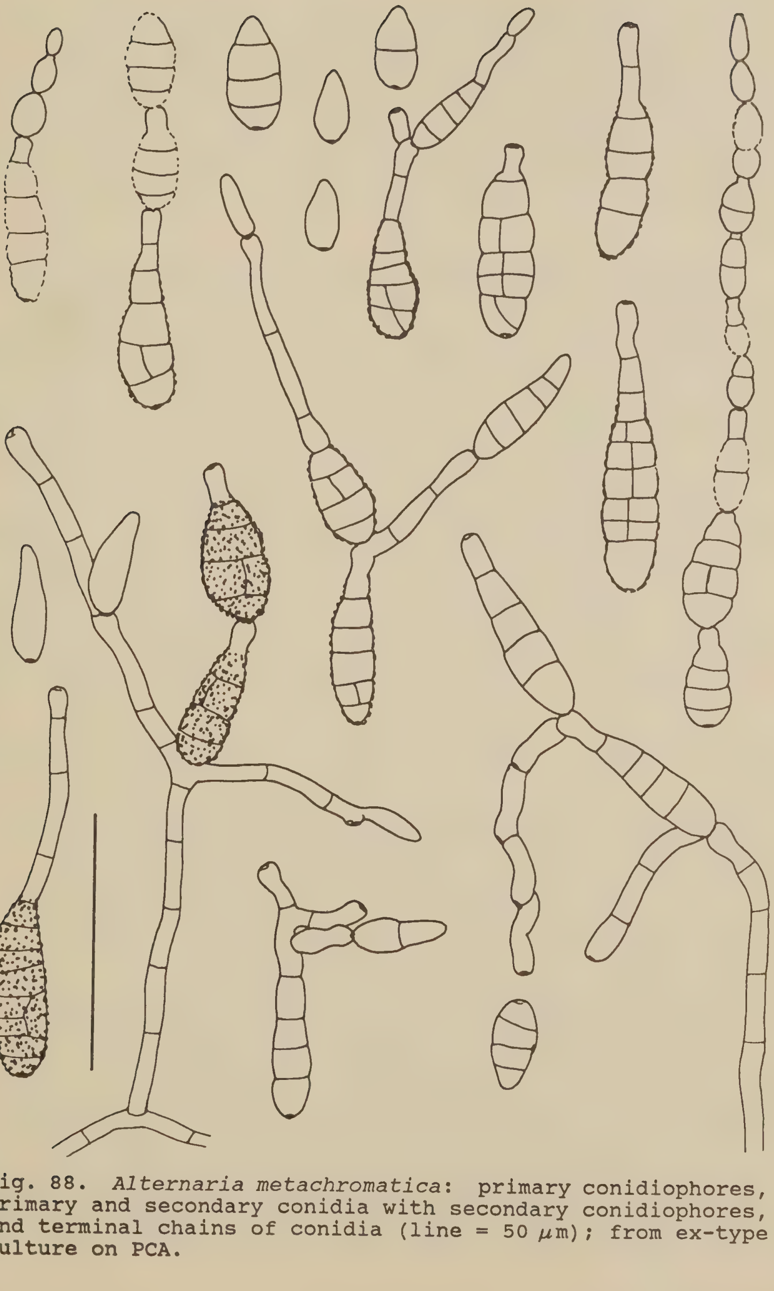

Fig. 88. *Alternaria metachromatica*: primary conidiophores, primary and secondary conidia with secondary conidiophores, and terminal chains of conidia (line = 50 μm); from ex-type culture on PCA.

The isolate (EGS 38-132) of *A. metachromatica* upon which this discussion and the dried-culture holotype are based was received in October 1985 via IMI 295682 as an "*Alternaria alternata* (albino strain)," isolated from seed of *Triticum aestivum* grown in South Australia. The strain is unique in that, except for truly hyaline variants, I have never seen another isolate of *Alternaria* with colors other than shades of brown or mixtures tending toward greenish or yellowish browns.

Hyaline, totally non-pigmented ("albino") strains of *Alternaria* occasionally arise spontaneously in otherwise ordinary dematiaceous colonies. They can be isolated easily and usually remain hyaline through periods of routine serial transfer and conservation. *A. metachromatica*, however, is not such a hyaline entity, for its pink color in simple lactic-acid-based mounting media and its blue color in culture and in water, though paler than the usual *Alternaria* browns, are not lost under these conditions. Nevertheless, I suspect that *A. metachromatica*, bright hued in the midst of innumerable dark-spored taxa, may prove eventually to have a dematiaceous analogue. The taxon should be recognizable in culture on the basis of its *A. infectoria* group affinity, viz., the initial decidedly pseudorostrate chain production, plus the enormous numbers of small, poorly septate conidia that make up the bulk of each large sporulation clump.

110. **Alternaria triticina** Prasada & Prabhu (1963) Fig. 89

Original material of *A. triticina* exists in the form of a field specimen holotype collected in India on leaves of *Triticum aestivum* (HCIO 27619; EGS 29-131) and a derivative isolate (Indian Type Culture Collection (Fungi) no. 1186 G.C.; EGS 17-061). The isolate remains in excellent sporulation condition 30 years after its initial isolation.

Simmons (1981, Alt.T&V 5) stressed the taxonomic importance of characteristics of conidia produced in culture and wondered whether or not the M. B. Ellis treatment of the taxon (1976) presented an accurate picture of the beak and ornamentation of conidia. It is obvious to me now, after restudying the material, that Ellis prepared his description from authenticated field material without reference to a culture. In any case, the kinds of beaks illustrated by Ellis and mentioned in Prasada and Prabhu are secondary conidiophores produced from the blunt or broadly tapered apex

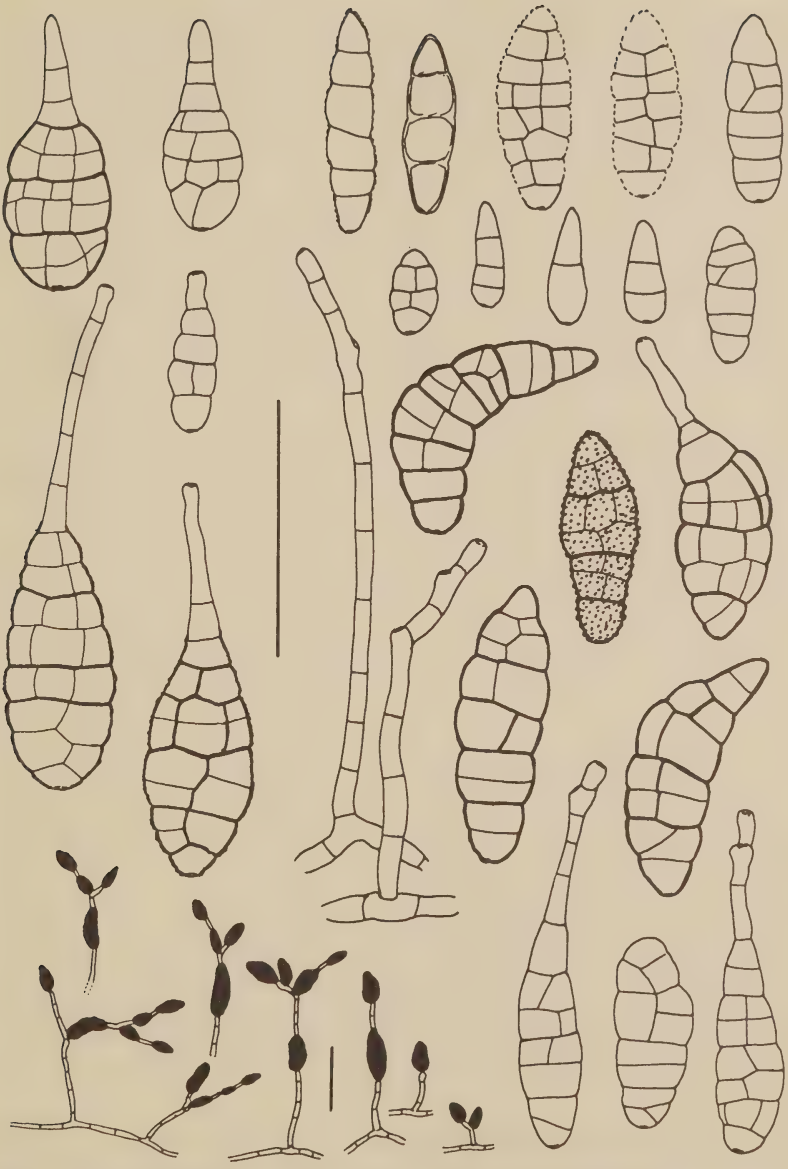

Fig. 89. *Alternaria triticina*: sporulation habit (conidium bodies opaque, conidiophores clear; line = 50 μm); primary conidiophores, conidia with secondary conidiophores, and terminal conidia (line = 50 μm); from ex-type culture on PCA.

of initially erostrate conidia. Walls of conidia present in the type, reported as smooth by Ellis and by the original authors, rarely have any visible roughness. In characters other than beak, the original description, that of Ellis, and the results of my examinations of the type specimen are essentially the same.

Primary conidia of *A. triticina* in the field specimen are at first narrow-ovoid, becoming broad-ovoid or broad-ellipsoid, beakless or broadly tapered, 50-80 x 20-25 µm, sometimes producing a secondary conidiophore 20-40 x 2-3 µm. Conidia have up to 8-9 complete or partial transverse septa and 1-3 longitudinal septa in each of the broadest transverse segments, are yellowish brown, and essentially smooth.

Colonies 5-7 days old on PCA sporulate abundantly as distinct clumps of only (1-)2-6 conidia borne on primary conidiophores that arise in large numbers directly from the agar surface as well as from sparse arachnoid aerial hyphae. Conidia are ovoid to broadly ovoid or ellipsoid, erostrate, often somewhat inequilateral, up to ca. 40-60 x 14-22 µm, dilute tawny brown, conspicuously punctate to verrucose, and up to 6-8 transeptate with 1-2 longisepta in each of 4-5 of the transverse segments. The pseudorostrum of primary conidia often becomes 1-geniculate and bears short pseudorostrate secondary conidia and erostrate terminal conidia.

The taxon is very distinctive, both in conidium morphology and particularly in the very restricted number of conidia per sporulation unit. The primary conidium in an *A. triticina* sporulation clump usually bears a well-developed geniculate pseudorostrum which, arguably, might permit its consideration as a rudimentary taxon of the *A. infectoria* group. However, it cannot be mistaken readily as any member of the *A. infectoria* group discussed above. No other usefully stable isolate that has reached me with a suggested determination of *A. triticina* (usually among miscellaneous isolates from wheat sent for opinion) has proved identifiable with the ex-type isolate, although there is abundant literature on the biology and pathology of the species.

111. **Alternaria triticicola** V. G. Rao (1964) Fig. 90

Authentic Rao material of *A. triticicola* is known from portions of field material on *Triticum aestivum* collected in India (HCIO 28262; EGS 29-132 and IMI 107601; EGS 24-145).

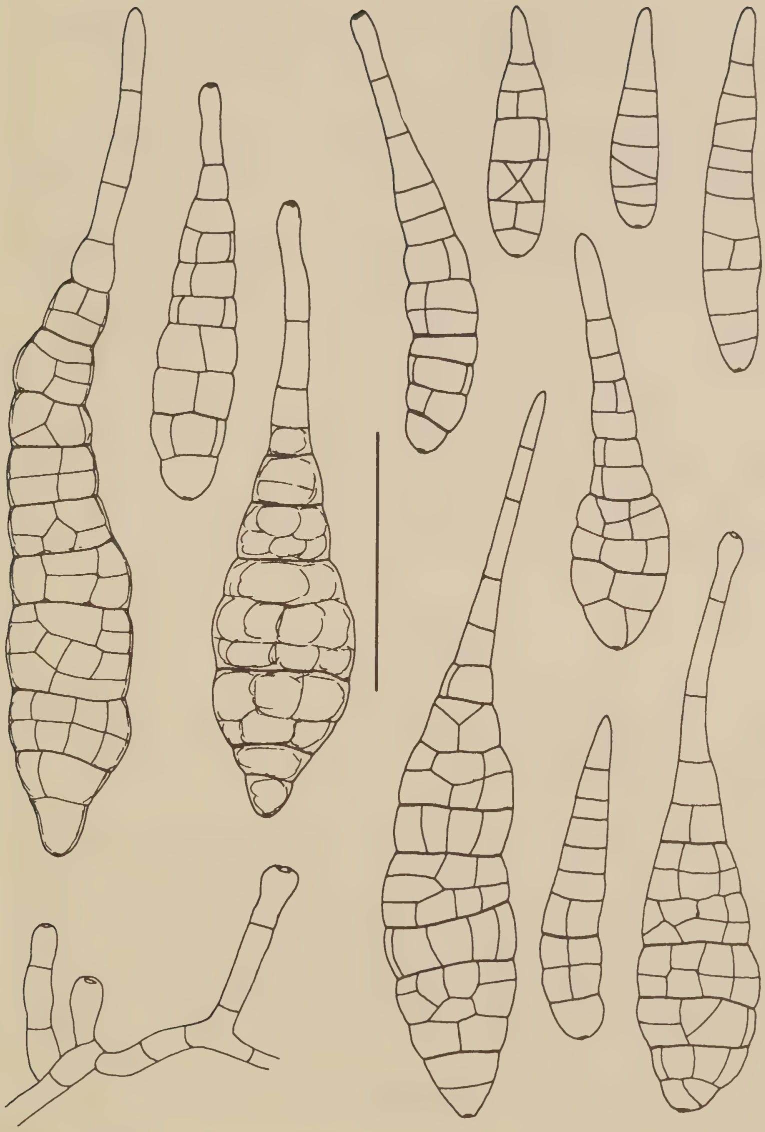

Fig. 90. *Alternaria triticicola*: primary conidiophores, primary conidia with apical secondary conidiophores, and terminal conidia from field specimen holotype (line = 50 µm).

These possibly are parts of the same collection but are not necessarily so (on evidence of specimen labels compared with type description data).

Conidia of *A. triticicola* in the field material are at first narrow-ellipsoid or long narrow-ovoid, ca. 60-70 x 10-15 μm, becoming broad-ovoid or broad-ellipsoid and broadly tapered, 80-160 x 18-25 μm, often producing an apical secondary conidiophore ca. 15-60 x 4-5 μm. Conidia have as many as 15-20 complete or partial transepta and 1-4 longisepta in most of the transverse segments; they are distinctly constricted at major transepta, clear tawny brown, and smooth.

The morphology of young conidia and of large conidia before pseudorostrum production, and the comparatively large size of fully developed conidia aid in differentiating *A. triticicola* from *A. triticina* (Alt.T&V 110). The proportion of pseudorostrate conidia to erostrate (i.e., terminal) conidia suggests that chain formation of several units (2-3 according to the type description) is characteristic of the taxon in nature.

ACKNOWLEDGEMENTS

My thanks continue to reviewer Dr. Mary E. Palm, who never lapses in catching mine. Her reviews and editorial comments on my manuscripts are always specific, valuable, and much appreciated.

The *Alternaria* taxon received from Ms. Analía Perelló in the course of her study of a related wheat disease in Argentina can be expected to be included in her future phytopathology papers. The sources of other *Alternaria* taxa from wheat are acknowledged gratefully: Australia (leg. incogn.) via IMI, International Mycological Institute, Egham, U.K.; India, HCIO, Indian Agricultural Research Institute, New Delhi; Oregon, U.S.A., C. L. Leach and R. L. Powelson.

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MENISPORA CONVOLUTA, A NEW DEMATIACEOUS HYPHOMYCETE FROM CENTRAL ITALY

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SUMMARY

A new dematiaceous Hyphomycete species, *Menispora convoluta*, found on juniper wood in central Italy, is described and illustrated.

Keywords: Hyphomycetes, Italy, *Menispora convoluta*.

During a mycological investigation carried out in the Castelporziano Presidential Estate, near Rome (Lunghini & Quadraccia, 1990; Quadraccia & Lunghini, 1990), the author found a species of *Menispora* Pers. on juniper wood, showing peculiar characteristics, but the scarcity and bad condition of the specimen did not allow a comprehensive study. A subsequent finding of the same species, also on juniper wood, near Campo Cecina (Alpi Apuane, Massa Carrara), made it possible to conclude the work and describe the following new species.

Menispora convoluta Lunghini sp. nov.

Coloniae effusae, haud constantes, lanatae villosaeve, umbrinae, conidiophora et setas steriles ferentes. Mycelium partim superficiale, partim immersum, ex hyphis septatis, ramosis, a subhyalino ad brunneum colorem variantibus, 1.5-4 µm crassis compositum.

Setae steriles amplitudine et colore conidiophoris similes sed raro ramis praeditae. Conidiophora setiformia, anguste conferta, luteo-brunnea, sursum

leviter attenuata, usque ad 950 µm longa et ad basim 3.5-5 µm crassa, septata, vulgo enormiter ramosa. Conidiophora exeunt in cellulas conidiogenas vel in longas setas sursum connvolutas et anguste inter se complicatas.

Cellulae conidiogenae phialidicae, subcylindricae, clavulatae, in parte inferiore rectae vel raro recurvatae, pallidiores quam conidiophori stipes, 24-48 µm longae et 3.5-5 µm crassae, repente obtruncatae, ad apicem conspicue recurvatae, sessiles aut praeditae brevi pediculo 2-4 cellularum instructo, collulo inconspicuo vel nullo praeditae. Phialides terminales rursus gignere possunt seu alteram phialidem seu setam convolutam.

Phialoconidia in capitulo mucido producta, hyalina, continua, subcylindrica vel cylindrico-ovata, leviter curvata, ad basim acutioria quam ad apicem, 17-23 x 3.5-4.2 µm, utrinque setula 5.5-9.5 µm longa praedita.

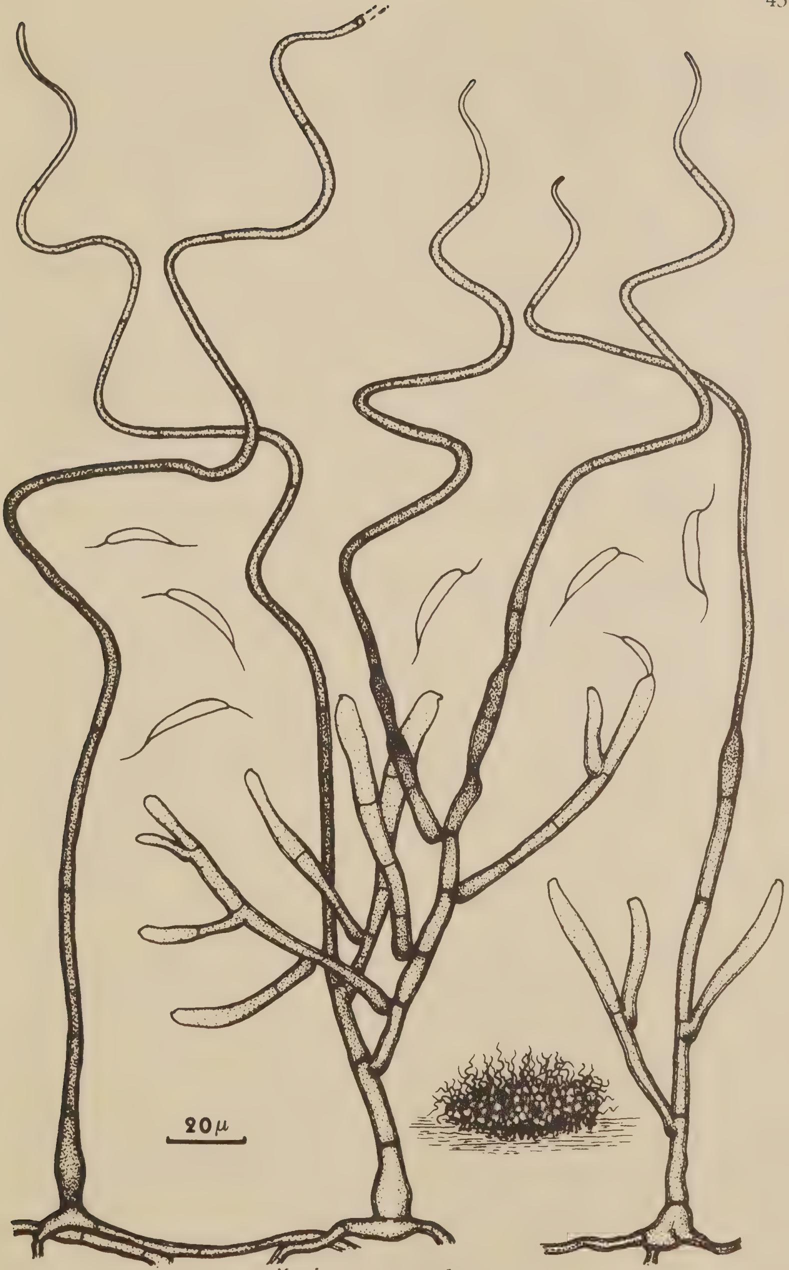
In ligno putrido Juniperi communis L., Campo Cecina (Alpi Apuane, Massa Carrara), Italy, Lunghini 5-11-1990, HOLOTYPUS: ROHB 140.

Additional specimen: on rotten wood of *Juniperus oxycedrus* L. ssp. *macrocarpa* (Sibth. et Sm.) Ball, Tenuta Presidenziale di Castelporziano, Roma, Italy, Lunghini 12-2-1989.

Colonies effuse, irregular, woolly to hairy, DARK BROWN, bearing noumerous conidiophores and sterile setae. Mycelium partly superficial, partly immersed, composed of septate, branched, subhyaline to brown, 1.5-4 µm wide hyphae.

Sterile setae similar in colour, size and appearance to conidiophores, but rarely branched. Conidiophores setiform, tightly crowded, YELLOWISH BROWN, paler towards the apex, up to 950 µm long, 3.5-5 µm wide near the swollen base, gradually tapering to 2 µm near the rounded apex, septate, repeatedly and irregularly branched. Conidiophores and their branches ending in conidiogenous cells or distally twisted setae, which become entangled with each other, but do not usually anastomose.

Conidiogenous cells subcylindrical, clavulate, straight or slightly curved in the lower part, paler than the conidiophore stipe, 24-48 x 3.5-5 µm, abruptly tapered and recurved at the apex, sessile or borne on short branches of 2-4 cells. Collarette inconspicuous or



Menispora convoluta Lunghini

absent. Terminal phialides sometimes proliferating percurrently into new phialides or developing coiled, seta-like extentions, that in turn can branch out, bearing new phialides and setae. Traces of proliferation are easily recognizable as constrictions along the full-grown stipes and branches of the conidiophore. Similar configurations can be found in some other phialidic hyphomycetes; even if they are usually remnants of percurrent proliferation, the light microscopic observation of the constrictions suggests continuity in the outer wall. This suggest an holoblastic mode of regeneration and development.

Conidia aggregated in slimy balls, hyaline, aseptate, subcylindrical or cylindrical-obovoid, slightly curved, asymmetrical, rounded at the distal end and tapered at the proximal end, 17-23 x 3.5-4.2 µm, bearing on either ends a single, 5.5-9.5 µm setula. An attempt to obtain this species in pure culture was unsucessful. No ascocarps of a teleomorph state were found.

The described species can easily be included in the genus *Menispora* Pers., mainly on the basis of the morphology of conidiogenous cells and conidia. Among the species ascribed to this genus, *M. convoluta* presents affinity with *M. gamsii* Hol.-Jech. and, to a lesser extent, *M. caesia* Preuss. *M. convoluta* differs from these species in having very coiled setae, more intricate branching, dissimilar colours and dimensions and in other minor features, but especially in the ability of the phialides to proliferate or produce holoblastically secondary sterile setae. Phialide proliferation is known in other *Menispora* species, viz. *M. uncinata* S. Hughes & B. Kendrick and *M. britannica* (M.B. Ellis) P.M. Kirk, but in these species proliferation is sympodial.

Moreover, it should be noted that in spite of the similarity of the substrata, the two localities differ considerably in climatic and biogeographical conditions.

Castelporziano Presidential Estate is a typical mediterranean environment at sea level, whereas Campo Cecina, on the Apuan Alps at about 1200 m above sea level, is a submountain station, even if influenced by mediterranean conditions. However, both localities can be considered as adverse to the survival of Hyphomycetes and the production of strongly coiled setae can be regarded as mode of protection for the conidia.

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MYCOTAXON

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REDISPOSALS AND REDESCRIPTIONS IN THE MONOCHAETIA - SEIRIDIUM, PESTALOTIA - PESTALOTIOPSIS COMPLEXES.

X. PESTALOTIA GRANATI AND PESTALOZZINA PUNICAE

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Pestalotia granati is redisposed in *Pestalotiopsis*. *Pestalozzina punicae* is considered a nomen dubium.

Husseinov (1968) gave an illustrated account of *Pestalotia granati* Husseinov from living leaves of *Punica granatum* collected in Azerbaijan (Commonwealth of Independent States - former U.S.S.R.). Diagnostic features for the species were presented as follows: 1) numerous black, epiphyllous, scattered to aggregated acervuli; 2) clavate, rarely subclavate, 4-septate conidia 17.5-20 X 5.5 µm, with brown or pale brown median cells with combined length of 11-14 µm; 3) colourless or almost colourless apical and basal cells; 4) filiform, divergent, apical appendages, 10-13 µm long, and 5) a basal appendage, 3-4 µm long.

Our study of the type specimen in LE 73885 leads us to conclude that the fungus is more appropriately disposed in *Pestalotiopsis* as *Pestalotiopsis granati*. The nomenclator and a revised description are presented below:

Pestalotiopsis granati (Husseinov) Nag Raj & Mel'nik **comb. nov.** Fig. 1.

≡ *Pestalotia granati* Husseinov, Mikol. i. Fitopatol. 2: 512, 1968.

Foliicolous. Conidiomata stromatic, pycnidioid, predominantly epiphyllous, scattered to gregarious, and often confluent, innate erumpent, appearing as angular, orbicular or irregular, pale brown or straw-coloured elevated pustules with glistening black centre, but after dehiscence wide open with a black mass of conidia extruded in long cirrhi, 110-360 µm wide, 70-100 µm deep, unilocular, glabrous; basal stroma and parietal tissue 10-15 µm thick, of almost colourless textura globulosa or textura angularis. Conidiophores lining the cavity of the conidioma, sparsely septate and branched only at the base, mostly reduced to conidiogenous cells, colourless, smooth, invested in mucus. Conidiogenous cells phialidic, ampulliform to lageniform, colourless except for the almost colourless apical part, smooth, 6-15 X 2-4 [$\bar{x}$ = 10.3 X 2.6] µm, with up to 4 percurrent proliferations. Conidia fusiform, 4-septate, 20-26 X 5-6 [$\bar{x}$ = 22.5

X 5.5] µm, bearing appendages; basal cell obconic with a truncate base, almost colourless, thin- and smooth-walled, 3.5-5 [x̄ = 4.2] µm long; median cells 3, doliiform to subcylindrical,

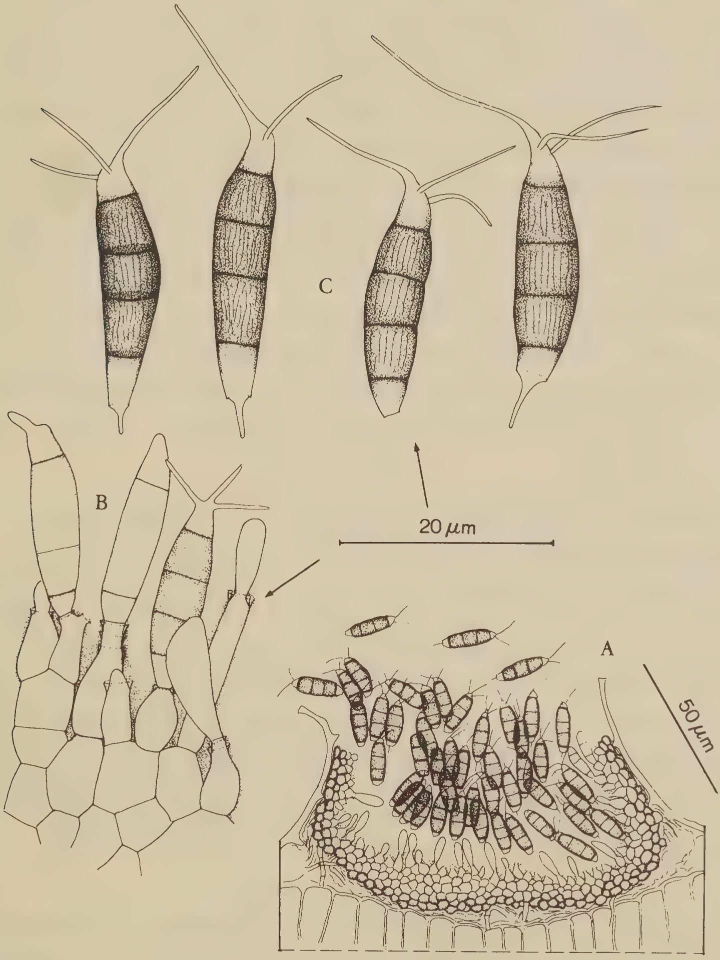

Figure. 1. *Pestalotiopsis granati* ex holotype in LE 73885. A. v.s. of a conidioma; B. Conidiogenous cells with developing conidia; C. Mature conidia.

with rugose walls, brown but often with the two upper cells darker than the lower cell, together 13-17 [x̄ = 14.5] µm long (second cell from the base 4.5-6.5 [x̄ = 5.3] µm; third cell 4.5 (-5) [x̄ = 4.5] µm; fourth cell 4-5 [x̄ = 4.6] µm); apical cell conical, almost colourless, thin- and smooth-walled, 3-4.5 [x̄ = 3.8] µm long; appendages tubular, unbranched, attenuated, flexuous; appendages on the apical cell 2-3, one of them axial and the others abaxial inserted at different loci, more or less proximal to the base of the axial appendage, 7-13(-16) [x̄ = 10] µm long; appendage on the basal cell, when present, single, unbranched, centric, up to 4 [x̄ = 2.3] µm long; mean conidium length/width ratio = 4.1:1.

Habitat: On living leaves of *Punica granatum*.

Specimen examined: LE 73885 [Type], pagum Kanar-Mesha, Dist. Lenkoran, Transcaucasia, Azerbaijan, 15.VII.1967, E.S.Husseinov.

Known distribution: Azerbaijan (Commonwealth of Independent States - former U.S.S.R.)

Teleomorph: Unknown.

Pestalotia jodhpurensis Bilgrami & Purohit, the only other species known to occur on *P. granatum* in India, belongs in *Pestalotiopsis* but is different from *Pestalotiopsis granati* in its conidium morphology and dimensions. *P. granati* is associated with greyish, round or irregular leaf spots, 1-1.3 cm wide.

Husseinov (1970) published the binomial *Pestalozzina punicae* for a fungus occurring on living leaves of *Punica granatum* [Evlach, Azerbaijan (Commonwealth of Independent States - former U.S.S.R.), 10.IX.1968, E.Husseinov]. The fungus, observed on small, brown, round or elongate spots, was reported to have: 1) amphigenous, small, brown acervuli; 2) cylindrical or oblong-clavate, 4-septate, colourless (yellowish in mass) conidia 15.6-23.3 X 4-5 µm, and 3) 2-3, filiform appendages at the apex, 5-13 X 1-1.5 µm and 4) a basal appendage 2.9-3.7 µm long. LE was the only reported repository for the type specimen; however, the specimen does not exist in that herbarium. The reported conidial dimensions fall well within the limits for *Pestalotiopsis granati*, but the published description and illustration of the fungus cast some doubts on its affinity with *Pestalotiopsis*. It is more likely to be a species of *Zetiasplozna* Nag Raj (Nag Raj 1993), but its true affinities cannot be ascertained at this time. We prefer to relegate the binomial to the status of a *nomen dubium*.

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CYLINDROCLADIUM NAVICULATUM SP. NOV., AND TWO NEW VESICULATE HYPHOMYCETE GENERA, *FALCOCLADIUM* AND *VESICLADIELLA*

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ABSTRACT

Cylindrocladium naviculatum is newly described and distinguished from other *Cylindrocladium* species based on its narrowly 1-septate conidia, naviculate vesicles, and cultural characteristics. *Falcocladium* and *Vesicladiella* are described as two new hyphomycete genera with white sporodochial conidiomata from *Eucalyptus* and *Araucaria* leaf litter respectively. Both genera are characterized by having thick-walled, non-septate stipe extensions that terminate in thin-walled vesicles. *Falcocladium* has appendaged, falcate conidia, whereas *Vesicladiella* has aseptate, cylindrical conidia. These genera are also distinguished from others such as *Cylindrodendrum*, *Cylindrocladium* and *Cylindrocladiella* by the morphology of their conidiomata and stipe extensions.

During collections of hyphomycete specimens from Brazil, a species of *Cylindrocladium* Morgan with naviculate vesicles was isolated from soil in Manaus, Amazonas, while a vesiculate hyphomycete with sporodochial conidiomata was isolated from *Eucalyptus* leaf litter at Aracruz in the State of Espirito Santo. The latter collection resembles the genera *Cylindrocladium* and *Cylindrocladiella* Boesewinkel in having hyaline stipe extensions terminating in well differentiated vesicles. Terminal vesicles and stipe extensions are, however, also found in genera such as *Cylindrodendrum* Bonorden and *Pulvinotrichum* Gamundi, Arambarri & Giaiotti. The aim of this study was to compare the *Cylindrocladium* isolate with all other taxa presently known in this genus. A comparison was also made of the morphology of the hyphomycete from *Eucalyptus* with that of *Cylindrodendrum* and *Pulvinotrichum* in order to suitably delineate these taxa based on their general morphology and cultural characteristics.

MATERIALS AND METHODS

Morphology

Cultures derived from single conidia were plated onto carnation-leaf agar (CLA) (Crous, Phillips & Wingfield, 1992), incubated at 25°C under near-ultraviolet light, and examined after 7 days in the case of the *Cylindrocladium* sp., and 14 days for the hyphomycete from *Eucalyptus*. Only material occurring on carnation leaves was examined. Mounts were prepared in lactophenol cotton blue. All measurements were made under the (100 x) oil-immersion objective.

The *Cylindrocladium* species (CPC 627-629) had 1-septate conidia and narrow, tapering vesicles, suggesting that it should be compared with other 1-septate species with similar vesicle morphologies such as *C. avesiculatum* Gill, Alfieri & Sobers (ATCC 38226), *C. candelabrum* Viegas (PPRI 4153), *C. clavatum* Hodges & May (PPRI 3994), *C. gracile* (Bugn.) Boesewinkel (PC 551197), *C. hawksworthii* Peerally (MUCL 30866), *C. pteridis* Wolf (PPRI 4157) and *C. scoparium* Morgan (ATCC 46300).

The fungus isolated from *Eucalyptus* leaf litter (CPC 589) produced hyaline sporodochia with several stipe extensions and terminal vesicles, suggesting a similarity to genera such as *Cylindrocladium*, *Cylindrocladiella*, *Cylindrodendrum*, *Uncigera* and *Pulvinotrichum*.

Cultural characteristics

Growth studies: To determine the maximum radial growth of species in culture, agar plugs (3 mm diam) from the periphery of young actively growing colonies of each fungus were plated at the centre of malt-extract agar (MEA) (20 g Oxoid malt extract, 15 g Difco agar, 1000 ml H_2O) plates, and incubated at 25°C for 1 day to ensure active growth. Growth after 1 day was noted, and thereafter, plates were placed in incubators at the temperatures under consideration. Isolates were incubated in the dark at 5, 8, 10, 15, 20, 25, 30, 33 and 35°C with three replicate plates of each isolate at each temperature. Growth was assessed after 6 days for the *Cylindrocladium* spp., and 14 days for the hyphomycete from *Eucalyptus*. Average growth was calculated from four radial measurements from each of the three plates.

Chlamydospores and colony colour: Colony colour and chlamydospore formation was determined at 25°C in the dark after 6 days for the *Cylindrocladium* spp., and after 14 days for the hyphomycete from *Eucalyptus*. Colour designations used were those of Rayner (1970).

RESULTS AND DISCUSSION

Cylindrocladium *sp. from soil:*

The *Cylindrocladium* species (CPC 627-629) collected in Manaus had naviculate vesicles, which were similar to those of young, developing vesicles of *C. candelabrum* (Crous, 1992). These two species could, however, be distinguished by the characteristic apical taper of the vesicles, the narrower conidia, moderate chlamydospore and slight microsclerotium formation in the fungus under investigation (Table 1). Other criteria that appear to be unique to this species are the frequent multiple-stipes occurring in a conidiophore, as well as the very wide stipe diameter observed just below the vesicle (Table 1). This species can easily be distinguished from all other 1-septate species of *Cylindrocladium* (Crous, 1992), and we therefore describe it here as new.

Cylindrocladium naviculatum Crous & Wingfield sp. nov. Figs 1, 5-8.

Etym.: named after its characteristic naviculate vesicles.
Macroconidiophora. *Fibra* septata, hyalina, terminata vesica naviculare, (6-)7.5(-11) μm diam; stipites (150-)180(-200) μm longi. *Rami conidiophori*: rami primarii non-septati vel raro 1-septati, (12-)18.5(-25) x (4-)4.5(-6) μm; rami secundarii non-septati, (10-)12(-15) x (4-)4.5(-6) μm; rami tertiani non-septati, (10-)12(-15) x (4-)4.5(-6) μm; rami quartani non-septati, (10-)11(-14) x 4(-5) μm. *Phialides* exorientes ex extremitatibus ramorum, 2-4 congregatae; phialides doliiformes vel reniformes, hyalinae, (9-)11.5(-15) x (3-)3.5(-4) μm. *Conidia* cylindrica, hyalina, 1-septata utrisque extremitatibus rotundatis, (40-)43(-55) x (3-)3.5(-4) μm. *Microconidiophora* ignota. *Teleomorpha* ignota.

Colonies (bottom) tawney 13'i (Rayner, 1970) on MEA, obtaining a radius of 28 mm after 6 days at 25°C in the dark. *Chlamydospores* in moderate numbers, forming fine chains with sparse microsclerotia. *Temperature requirements for growth*: minimum temperature above 5°C, maximum temperature above 35°C, optimum temperature 25°C. *Macroconidiophores*. *Stipe extension* septate, hyaline, terminating in a naviculate vesicle, (6-)7.5(-11) μm diam; stipes (150-)180(-200) μm long. *Conidiophore branches*: primary branches non-septate or rarely 1-septate, (12-)18.5(-25) x (4-)4.5(-6) μm; secondary branches non-septate, (10-)12(-15) x (4-)4.5(-6) μm; tertiary branches non-septate, (10-)12(-15) x (4-)4.5(-6) μm; quaternary branches non-septate, (10-)11(-14) x 4(-5) μm. *Phialides* arise from the ends of branches, in groups of 2, 3 or 4; phialides doliiform to reniform, hyaline, (9-)11.5(-15) x (3-)3.5(-4) μm. *Conidia* cylindrical, hyaline, 1-septate rounded at both ends, (40-)43(-55) x (3-)3.5(-4) μm. *Microconidiophores* not present. *Teleomorph* not present.

Holotype: Brazil: Amazonas State, Manaus, soil, M.J. Wingfield, Apr. 1993, PREM 51542.

Cultures examined: Brazil: Amazonas State, Manaus, soil, M.J. Wingfield, Apr. 1993, CPC 627 (culture of type); other collections from the same location, CPC 628, 629.

Hyphomycete from* Eucalyptus *leaf litter:

The hyaline hyphomycete collected from *Eucalyptus* leaf litter (CPC 589) grew and sporulated profusely in culture. Numerous thick-walled, dark brown chlamydospores were common, and were also characteristic of *Cylindrocladium, Cylindrocladiella*, *Cylindrodendrum* and *Pulvinotrichum*.

Conidiomata are hyaline, but frequently have light brown bases. These structures originated either from hyphae, or from stromata comprised of chlamydospores. Conidiomata are penicillate or synnematal, but more frequently aggregated in sporodochia. Single conidiophores include several branches, terminating in a whorl of short to elongate ampulliform phialides. Each conidiophore has one to several thick-walled, non-septate stipe extensions which terminate in thin-walled, ellipsoidal vesicles. These stipe extensions originated randomly throughout the conidiomata, and are not restricted to the terminal ends of branches or phialide positions as is found in species of *Cylindrocladium*

Fig. 1. *Cylindrocladium naviculatum*. A, conidia; B, naviculate vesicles; C, conidiophore (bar = 10 μm).

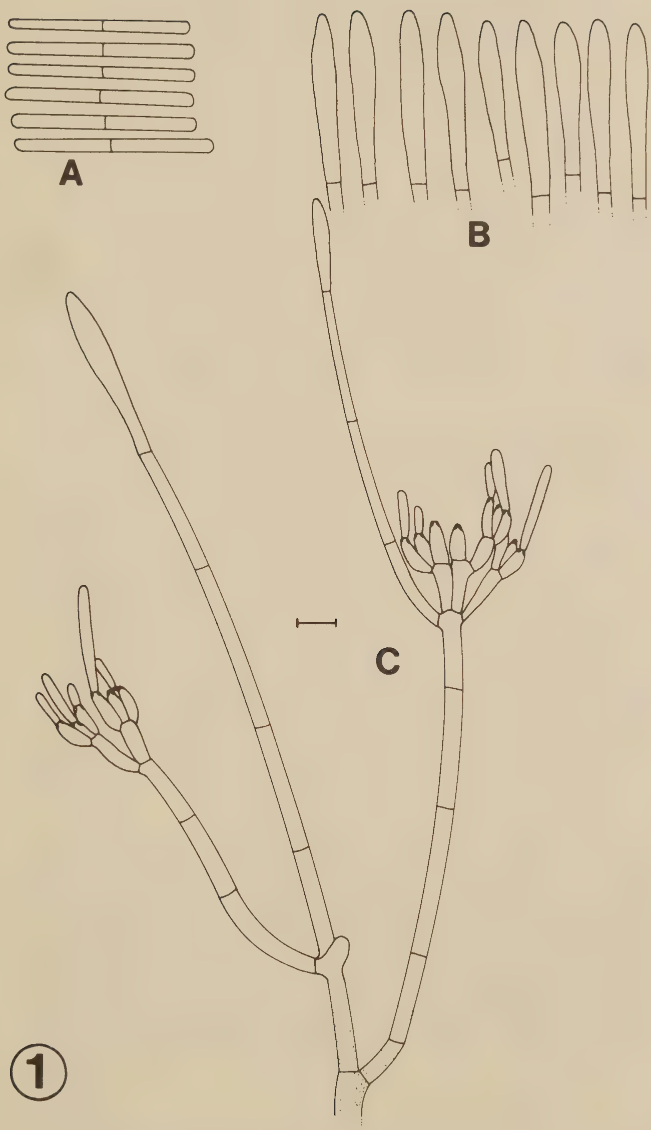

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Table1. A comparison of the morphological[a] and cultural characters of the 1-septate *Cylindrocladium* species studied

Species	Accession No.	Conidium Dimensions (Length x Width) (*u*m)	Stipe (*u*m) Length	Stipe (*u*m) Width Below Vesicle	Vesicle Shape	Vesicle Width (*u*m)	Temperature Requirements For Growth (°C)[b] Minimum	Optimum	Maximum	Colony Colour[c] (bottom)	Chlamydospores[c]
C. avesiculatum	ATCC 38226	(57-)64(-77) x(4.5-)5(-6.5)	(190-)265(-360)	(2.5-)3	avesiculate to narrowly clavate	(1.5-)2.5(-4)	>8	25	<35	13k	extensive
C.candelabrum	PPRI 4153	(33-)45(-66) x(3.5-)4(-4.5)	(105-)180(-290)	(2.5-)3(-3.5)	ellipsoid to obpyriform	(6-)8(-10)	>5	25-30	>35	13k-17'i-15"i	extensive
C. clavatum	PPRI 3994	(38.5-)45(-52) x(4-)4.5(-6)	(140-)200(-260)	(2.5-)3(-3.5)	clavate	(3.5-)4.5(-6)	>10	25	<35	13k-17"k	extensive
C. gracile	PC 551197	(40-)56(-65) x4(-5)	(160-)220(-350)	2.5(-3.5)	clavate	(2.5-)3.5(-5)	>10	30	>35	13k-17"k	extensive
C. hawksworthii	MUCL 30866	(42-)55.5(-76) 4(-4.5)	(150-)200(-250)	(2.5-)3(-3.5)	ellipsoid to clavate	(6-)6.5(-8.5)	>5	30	<35	13"k	extensive
C. naviculatum[d]	CPC 627	(40-)43(-55) x(3-)3.5(-4)	(150-)180(-200)	(3.5-)4(-5)	naviculate	(6-)7.5(-11)>	>5	25	>35	13i	moderate
C. pteridis	PPRI 4157	(62.5-)82(-121) x5(-6)	(150-)240(-300)	(2.5-)3(-4)	clavate	(4-)4.5(-5.5)	>10	30-33	>35	13k-13m	extensive
C. scoparium	ATCC 46300	(40-)45(-66) x(3.5-)4(-4.5)	(150-)173(-195)	3(-4)	obovoid to pyriform or ellipsoid	(6-)6.5(-8)	>5	25-30	>35	13k-17'i-15"i	extensive

[a] Determinations made on carnation-leaf agar after 7d at 25 °C under near-ultraviolet light.

[b] Rated on three MEA plates after 6d, incubated at 5, 8, 10, 15, 20, 25, 30, 33 and 35 °C in the dark.

[c] Rated on three MEA plates after 6d at 25 °C in the dark. Colour designations according to Rayner (1970). Dark brown = extensive; medium brown = moderate; light brown to cream = slight.

[d] A new species.

or *Cylindrocladiella*. The most characteristic feature of this fungus is its falcate conidia. Conidia also have short basal appendages which occur at the inner, shorter curve of the conidium, and inconspicious, short apical appendages, continuous with the rest of the conidium.

Generic considerations:

Cylindrocladium and Cylindrocladiella: Arguments for separating these genera have been presented elsewhere (Crous, 1992; Crous & Wingfield, 1993). The vesiculate fungus under discussion here is distinct from all *Cylindrocladium* species (Crous, 1992) in having non-septate, thick-walled stipe extensions, and falcate conidia (Figs 2, 3). Although the nature of the stipe is similar to that of *Cylindrocladiella* spp. (Fig. 4), these never form sporodochial conidiomata, or have falcate conidia (Crous & Wingfield, 1993).

Cylindrodendrum, Pulvinotrichum and Uncigera: Summerbell *et al.* (1989) recently compared these three genera, and concluded that they are congeneric. *Cylindrodendrum* is characterized by conidiomata composed of erect, hyaline hyphae bearing whorls of phialides. The only character distinguishing *Cylindrodendrum* from *Uncigera* (Di Cosmo *et al.*, 1983) is the strongly bent apical portions of the phialides in *Uncigera*. Summerbell *et al.* (1989), however, also observed this characteristic in *Cylindrodendrum*, and thus reduced *Uncigera* to synonymy with it. Furthermore, in an examination of the type specimen of *Pulvinotrichum*, Summerbell *et al.* (1989) found the same characteristic conidiomatal and phialide morphology to be present, thus supporting the synonymy of *Pulvinotrichum* and *Cylindrodendrum* with the latter genus having priority.

The nature of the stipe extension, the branching pattern of the conidiophore, and terminal vesicle in *Cylindrodendrum* as illustrated by Arambarri *et al.* (1981) and Summerbell *et al.* (1989) are distinct from those observed in *Cylindrocladium*, *Cylindrocladiella*, as well as from those of the hyphomycete from *Eucalyptus* under investigation here. Furthermore, the distinct falcate conidia of this fungus preclude it from being suitably accommodated in any of these genera. The new genus *Falcocladium* is therefore proposed for this fungus.

Falcocladium Silveira, Alfenas, Crous & Wingfield gen. nov.
Etym.: named after its falcate conidia.

Conidiomata hyalina, sporodochialia vel synnematalia, vel penicillata quum formata sint in mycelio aerio, reperta singulatim, sed saepius aggregata, exorientia ex mycelio ipso vel ex stromate crassitunicatarum et rufobrunnearum chlamydosporarum quum hic fungus cultus est in CLA; stipitis extensiones hyalinae, non-septatae, crassitunicatae, exorientes ex qualibet positione in ramo conidiomatali, vel in positione phialidis, et plures quam una saepe repertae sunt in penicillato conidiomate eodem. *Rami conidiophori* hyalini, non- vel multiseptati, usque tres series ramorum per conidioma. *Phialides* hyalinae, exorientes ex extremitatibus ramorum, congregatae 2-6, ampulliformes, collariculis inconspicuis. *Conidia* hyalina, 0(-1)-septata, falcata acutis brevibus apicalibus et basilaribus appendicibus.

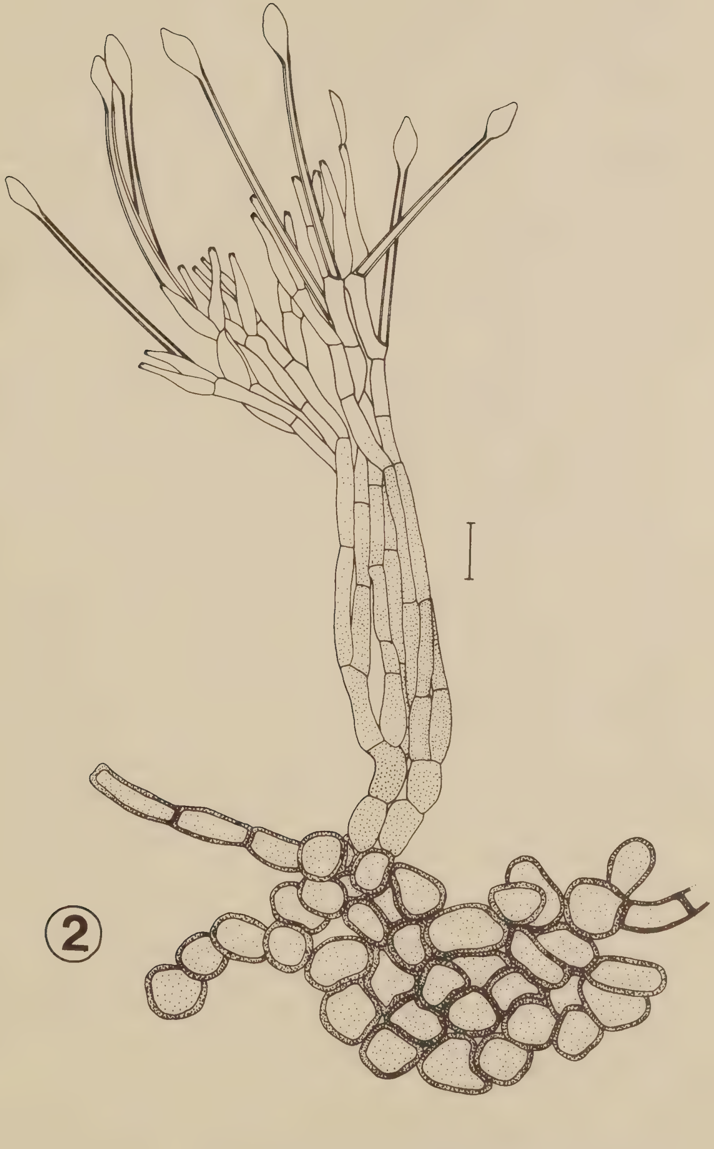
Colonies dark brown on MEA with brown, thick-walled chlamydospores. *Conidiomata* hyaline, sporodochial or synnematal, or penicillate when formed on aerial mycelium, occurring singly, but more frequently aggregated, arising directly from the mycelium, or from a stroma of thick-walled, red-brown chlamydospores when cultured on CLA; stipe extensions hyaline, non-septate, thick-walled, originating from any position on a conidiomatal branch, or in the position of a phialide, frequently with more than one occurring in the same penicillate conidioma. *Conidiophore branches*, hyaline, non- to multi-septate, up to three series of branches per conidioma. *Phialides* hyaline, arising from ends of branches, in groups of 2-6, ampulliform, with inconspicious collarettes. *Conidia* hyaline, 0(-1)-septate, falcate with acute, short apical and basal appendages.

Sp. typ. *F. multivesiculatum*

Falcocladium multivesiculatum Silveira, Alfenas, Crous & Wingfield sp. nov. Figs 2, 3, 9-11, 14-19.

Etym.: named after the numerous vesicles occurring on conidiomata. *Conidiomata* sporodochialia vel synnematalia, vel penicillata quum formata sint in mycelio aerio, reperta singulatim, sed saepius aggregata, exorientia ex mycelio ipso vel ex stromate crassitunicatarum rufobrunnearum chlamydosporarum quum hic fungus cultus sit in CLA; stipitis extensiones hyalinae, non-septatae, crassitunicatae, (45-)60(-80) μm (mensurae a septo basilari usque ad acumen vesicae),

Fig. 2. Synnematal conidioma of *Falcocladium multivesiculatum* arising from a stroma of chlamydospores (bar = 10 μm).



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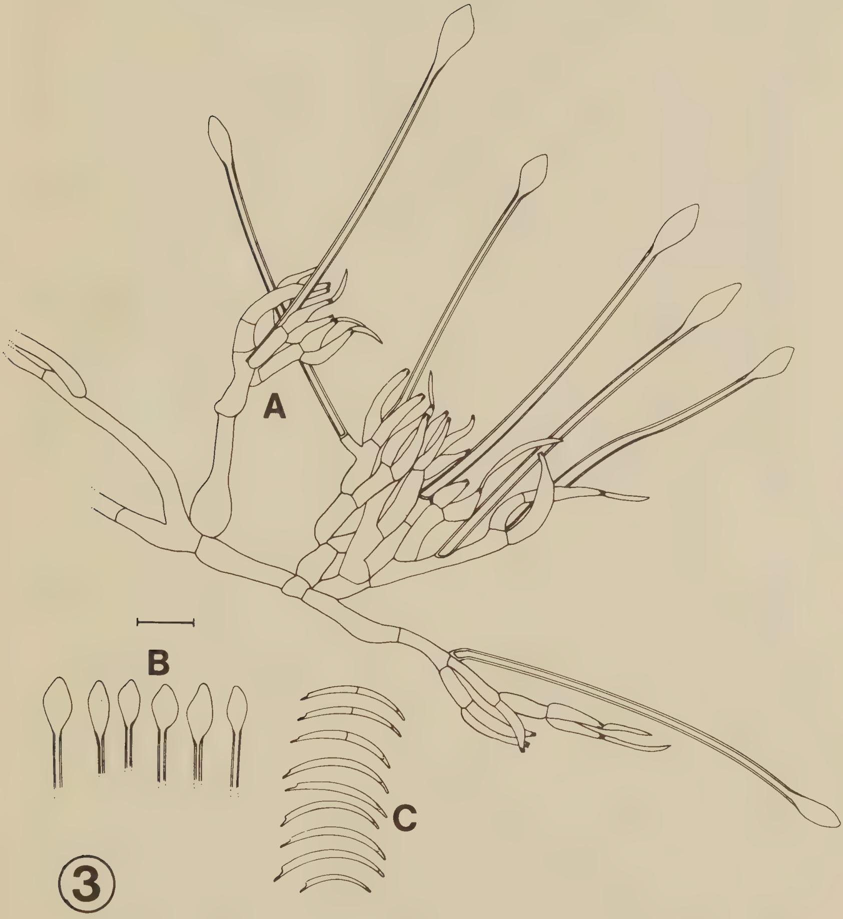
exorientes ex positione qualibet in ramo conidiomatali, vel in positione phialidis, plures quam una saepe repertae sunt in conidiomate eodem penicillato. *Rami conidiophori*, rami primarii hyalini vel pallide brunnei, 0-4-septati, 11-95 x 3.5-5 μm; rami secundarii hyalini, 0-2-septati, 10-80 x 3.5-5 μm; rami tertiani hyalini, 0-2-septati, 10-50 x 3.5-5 μm. *Phialides* hyalinae, exorientes ex extremitatibus ramorum, 2-6 aggregatae, ampulliformes, 13-60 x 4-7 μm; collaricula inconspicua. *Conidia* hyalina, 0(-1)-septata, falcata, acutis brevibus apicalibus basilaribusque appendicibus, (12-)14(-20) x 1.5(-2) μm (appendicibus exclusis); appendices basilares sitae in interiore breviore convexa conidica flexione, 1-3 μm longae, terminatae apice obtuse rotundato; appendix apicalis continua conidio, 1.5-2 μm longa, terminata apice obtuse rotundato.

Colonies (bottom) 13'k verona brown (Rayner, 1970) on MEA, attaining a radius of 7 mm after 14 days at 25°C in the dark; aerial mycelium sparse, margins irregular. *Chlamydospores* dark brown, arranged in chains, 10-20 μm long, 5-11 μm wide. *Temperature requirements for growth*, minimum temperature above 10°, optimum temperature 20-25°, maximum temperature below 35°. *Conidiomata* sporodochial or synnematal, or penicillate when formed on aerial mycelium, occurring singly, but more frequently aggregated, arising directly from the mycelium, or from a stroma of thick-walled, red-brown chlamydospores when cultured on CLA; stipe extensions hyaline, non-septate, thick-walled, (45-)60(-80) μm (measured from basal septum to vesicle tip), originating from any position on a conidiomatal branch, or in the position of a phialide, frequently with more than one occurring in the same penicillate conidioma. *Conidiophore branches*, primary branches hyaline to light brown, 0-4-septate, 11-95 x 3.5-5 μm; secondary branches hyaline, 0-2-septate, 10-80 x 3.5-5 μm; tertiary branches hyaline, 0-2-septate, 10-50 x 3.5-5 μm. *Phialides* hyaline, arising from ends of branches, in groups of 2-6, ampulliform, 13-60 x 4-7 μm; collarettes inconspicious. *Conidia* hyaline, 0(-1)-septate, falcate with acute, short apical and basal appendages, (12-)14(-20) x 1.5(-2) μm (excluding appendages); basal appendages situated on the inner, shorter, convex, conidial curve, 1-3 μm long, terminating in bluntly rounded apices; apical appendages continuous with conidia, 1.5-2 μm long, terminating in bluntly rounded apices.

Fig. 3. Penicillate conidiomata of *Falcocladium multivesiculatum* arising from aerial mycelium (bar = 10 μm).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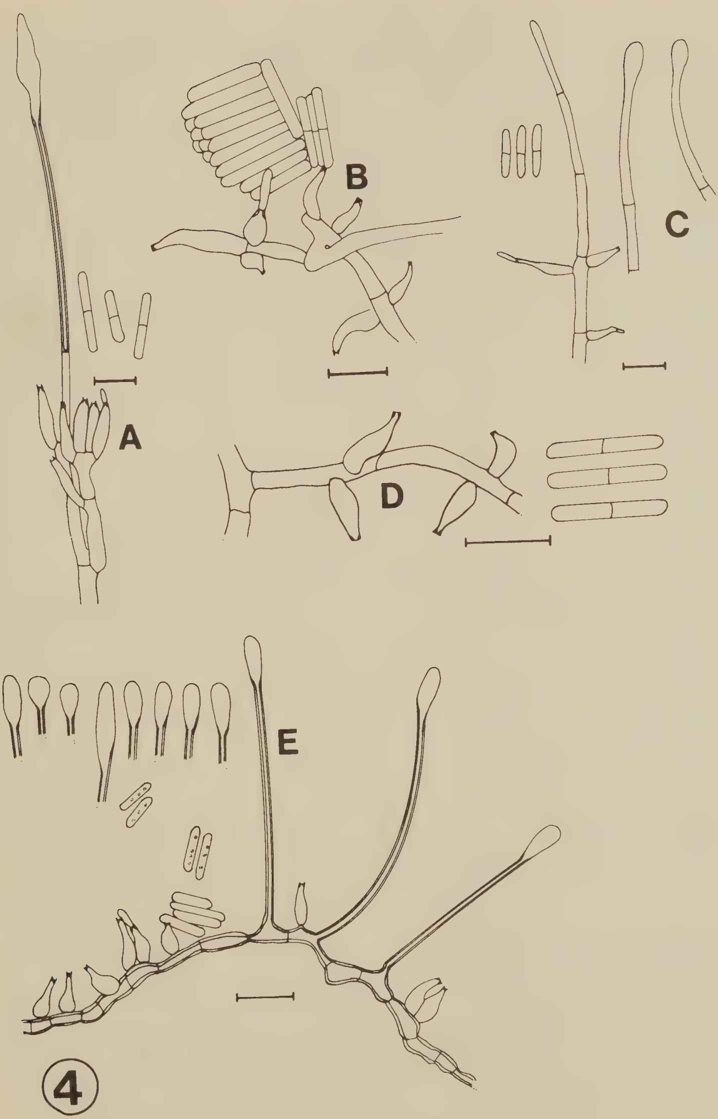
Holotype: Brazil, Espirito Santo, Aracruz, *Eucalyptus grandis* leaf litter, Silvaldo F. Silveira, Jan. 1993, PREM 51541.

Additional specimens and cultures examined: *Cylindrodendrum album* Bonorden, Australia, NSW, Bellangry forest, Wilson River Reserve, on a dead grass blade in middle of Wilson River, leg. R.V. Bandoni, det. K. Seifert, 18 Aug. 1981, CBS 3484; *Pseudomicrodochium candidum* (Bres.) de Hoog, Belgium, near Eupen, decaying leaf of *Ilex aquifolium*, Leg. & det. W. Gams, 17 Oct. 1981, Netherlands, Callantsoog, dead leaf of *Quercus*, leg. W. Gams, Oct. 1979, CBS (no number assigned); *Pulvinotrichum album* Gamundi, Arambarri & Giaiotti, Argentina, Pla. Quetrihue, leaves of *Nothofagus dombeyi*, leg. P. Benavente, 19 Oct. 1977, LPS 40140; *Pulvinotrichum capitatum* Sutton, Australia, Queensland, Boombana, M.P., leaf litter of *Araucaria bidwillii*, leg. B.C. Sutton & J.L. Alcorn, 27 Aug. 1981, IMI 263277a; *Cylindrocladiella elegans* Crous & Wingfield, RSA, Natal, Seven Oaks, leaf litter, leg. I. Rong, 11 Oct. 1989, PPRI 4050 (culture); *Cylindrocladium colhounii* Peerally var. *colhounii*, Brazil, unknown host, leg. A.C. Alfenas, 1991, PPRI 4183 (culture).

When synonymizing *Uncigera* and *Pulvinotrichum* with *Cylindrodendron* Summerbell *et al*. (1989), noted that further collections, cultural, as well as type specimen studies would be required to consider possible synonymies among the species previously described in these three genera. Unfortunately Sutton (1989) described a new species, *Pulvinotrichum capitatum* Sutton in the same year. The latter collection was placed in *Pulvinotrichum* due to its sporodochial conidiomata, as well as the presence of stipe extensions with terminal vesicles as illustrated by Arambarri *et al*. (1981). An examination of *P. capitatum* (IMI 263277a) however, showed that in spite of several similar characteristics, this species cannot be accommodated in *Cylindrodendrum*. The conidia of *P. capitatum* are cylindrical, aseptate, and carried in cylindrical packets. The same was also found to be true for several collections of *Cylindrodendrum* that we examined. Furthermore, phialides of *P. capitatum* could also be

Fig. 4. *Falcocladium* and morphologically similar genera. A, Penicillate conidiophore of *Cylindrocladiella camelliae* (CPC 395); B, phialides and conidia of *Cylindrodendrum album* (CBS 3484); C, phialides, conidia and vesicles of *Cylindrodendrum album* var. *paralion* (redrawn from Summerbell *et al*., 1989); D, curved phialides and conidia of *Cylindrodendrum album* (type of *Pulvinotrichum album*, LPS 40140); E, conidiophores with phialides, conidia and vesicles of *Vesicladiella capitatum* (IMI 263277a) (bar = 10 μm).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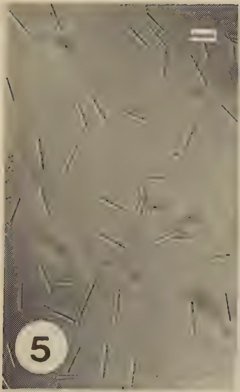
accommodated within the range of variation described for *Cylindrodendrum*, with some also having the characteristically abrupt apical bend to the upper part of the phialide (Fig. 4).

Pulvinotrichum capitatum and *Cylindrodendrum* differ in the nature of the stipe extension and the phialide bearing hyphae (Fig. 4). In *P. capitatum*, stipe extensions are thick-walled, non-septate, with several occurring in every conidioma, and branched at 90° to the basal hyphae. This was never the case in *Cylindrodendrum*, where stipe extensions were rare, septate, thin-walled, and rather extensions of fertile developing hyphae with indeterminate growth. Colonies are also not as floccose as those of *Cylindrodendrum*. Furthermore, in contrast to *Cylindrodendrum* where the phialide bearing hyphae are erect, thin-walled, and carry whorls of phialides, hyphae of *P. capitatum* are thick-walled, occur on the substrate surface, with the phialides not arranged in whorls. Although the morphology of the stipe extension in *P. capitatum* is similar to that in *F. multivesiculatum*, the conidiomata and conidia are distinct, also making *Falcocladium* unsuitable for this fungus.

Because *P. capitatum* cannot be suitably accommodated in any of the genera discussed above, we herewith propose a new genus, *Vesicladiella* for this fungus.

Vesicladiella Crous & Wingfield gen. nov.
Etym.: Named after the characteristic vesicles resembling those of the hyphomycete genus *Cylindrocladiella*.
Coloniae sparsae, albae. *Mycelium* hyalinum, crassitunicatum, leve, septatum. *Conidiomata* sporodochialia, disseminata vel gregaria, alba; extensiones stipitis erectae, crassitunicatae, irramosae, terminatae vesicis tenuitunicatis. *Conidiophora* reducta in cellas conidiogenas. *Phialides*

Figs 5-13. Conidiophores, conidia and vesicles of *Cylindrocladium naviculatum*, *Falcocladium multivesiculatum* and *Vesicladiella capitatum*. Figs 5-8. *Cylindrocladium naviculatum*. Fig. 5. Conidiophore (bar = 45 μm). Fig. 6. Conidiophore branches with phialides (bar = 9 μm). Fig. 7. One septate conidia (bar = 9 μm). Fig. 8. Conidiophore branches and a naviculate vesicle (bar = 9 μm). Figs 9-11. *Falcocladium multivesiculatum* (bars = 9 μm). Fig. 9. Multivesiculate synnematal conidiophore. Fig. 10. Synnematal conidiophore on a stroma of chlamydospores. Fig. 11. Falcate conidia with apical and basal appendages. Figs 12, 13 (bars = 9 μm). *Vesicladiella capitatum*. Fig. 12. Stipe extension with terminal vesicle. Fig. 13. Cylindrical conidia.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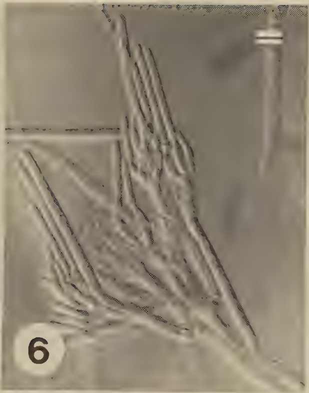
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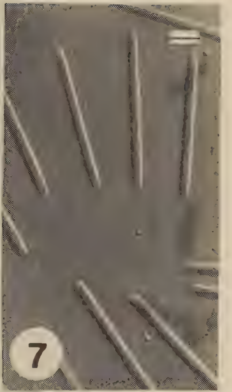
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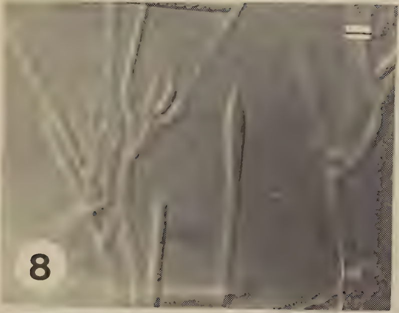
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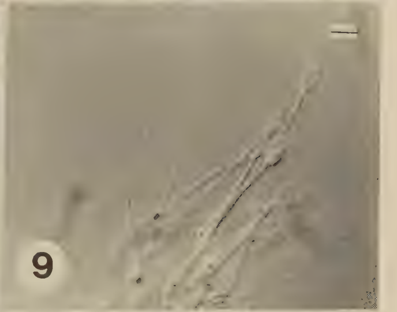
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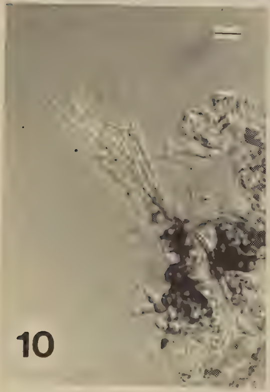
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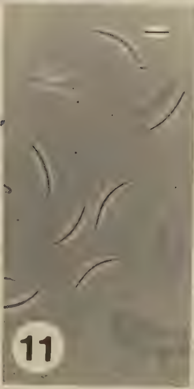
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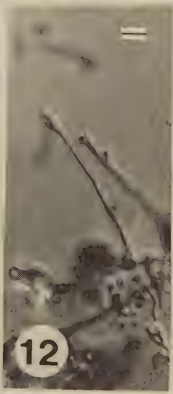
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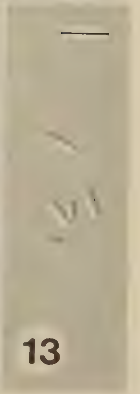
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discretae, determinatae, intercalares vel laterales, ampulliformes; collaricula praesentia. *Conidia* hyalina, non-septata, levia, cylindrica extremitatibus rotundatis, guttulata.

Colonies sparse, white. *Mycelium* hyaline, thick-walled, smooth, septate. *Conidiomata* sporodochial, scattered to gregarious, white; stipe extensions erect, thick-walled, unbranched, terminating in a thin-walled vesicle. *Conidiophores* reduced to conidiogenous cells. *Phialides* discrete, determinate, intercalary or lateral, ampulliform; collarettes present. *Conidia* hyaline, non-septate, smooth, cylindrical with rounded ends, guttulate.

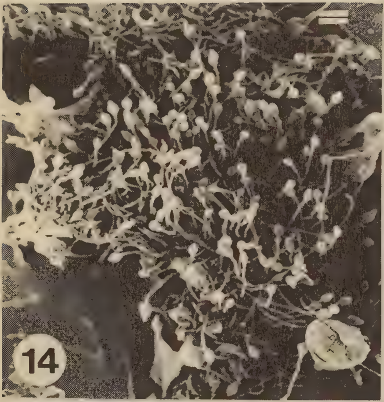
Holotype: Australia, Queensland, Boombana, M.P., leaf litter of *Araucaria bidwillii*, leg. B.C. Sutton & J.L. Alcorn, 27 Aug. 1981, IMI 263277a

Sp. typ. *V. capitatum*

Vesicladiella capitatum (Sutton) Crous & Wingfield comb. nov. Figs 4, 12, 13.
Pulvinotrichum capitatum Sutton, *Sydowia* **41**: 338 (1989) (basionym).
Colonies sparse, white. *Mycelium* hyaline, thick-walled, smooth, septate. *Conidiomata* sporodochial, scattered to gregarious, white; stipe extensions erect, thick-walled, unbranched, up to 160 μm long (from basal septum to vesicle tip), 2-3 μm wide at the base, terminating in a thin-walled clavate to ellipsoid vesicle, 3-5 μm wide. *Conidiophores* reduced to conidiogenous cells. *Phialides* discrete, determinate, intercalary or lateral, ampulliform, 2.5-4 μm wide at base, up to 1 μm wide at apex; collarettes present. *Conidia* hyaline, non-septate, smooth, cylindrical with rounded ends, guttulate, 6-9 x 1.5 μm.

The description of two new vesiculate hyphomycete genera from *Eucalyptus* and *Araucaria* leaf litter suggests that there are many genera on these substrates yet to be discovered and described. Additional collections and cultural studies with the possibility of new teleomorph connections would suitably strengthen these arguments, and also provide

Figs 14-19. *Falcocladium multivesiculatum* (bars = 10 μm). Fig. 14. Multivesiculate synnematal conidiophore. Fig. 15. Penicillate conidiophore with several stipe extensions. Figs 16, 17. Whorls of tapering, ampulliform phialides (apices arrowed), forming flacate conidia. Fig. 18. Falcate conidia with apical and basal appendages. Fig. 19. Conidiophore with falcate conidia arranged in a round packet.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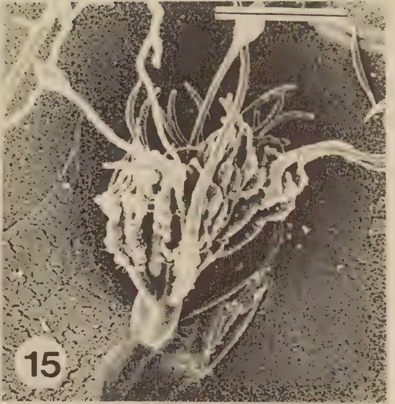
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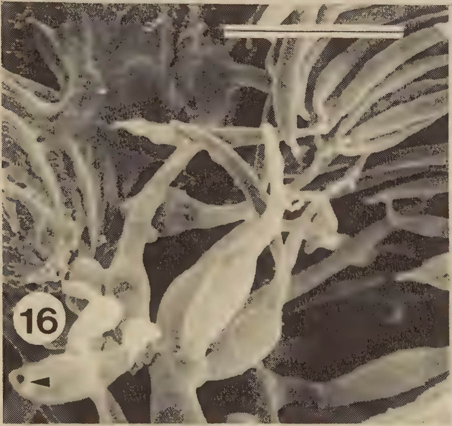
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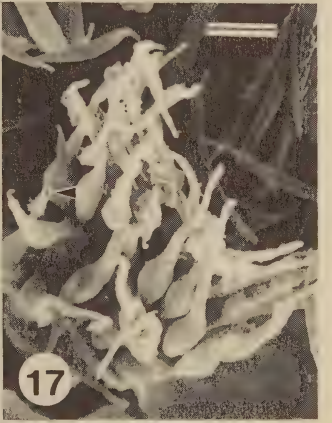
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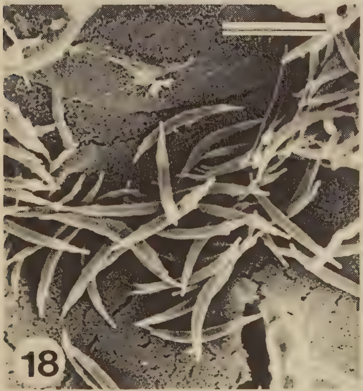
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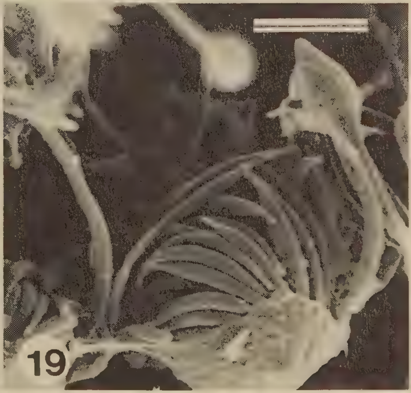
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additional clues as to their possible relationships with other, morphologically similar genera discussed in this study.

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WENTIOMYCES LICHENICOLA SUBSP. NOV. *BOUTEILLEI* CHAMPIGNON LICHÉNICOLE NON LICHÉNISÉ (DOTHIDEALES, DIMERIACEAE)

par Claude Roux *, Olivier Bricaud *,
Emmanuël Sérusiaux ** et Clother Coste ***

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Résumé

Wentiomyces lichenicola (Hansf.) D. Hawksw. subsp. *bouteillei* Bricaud, Roux et Sérusiaux subsp. nov. diffère de la sous–espèce *lichenicola* par sa spécificité parasitaire (sur *Fellhanera bouteillei*, exceptionnellement sur *Bacidina* sp.), ses hyphes d'ancrage peu visibles, moins longues, plus minces et nettement plus claires, et sa répartition (Europe, Asie et Amérique du Sud). Mise en évidence de périphyses rudimentaires chez *Wentiomyces lichenicola*.

Resumo

Wentiomyces lichenicola (Hansf.) D. Hawksw. subsp. *bouteillei* Bricaud, Roux et Sérusiaux subsp. nov. diferencas de la subsp. *lichenicola* pro specifa loĝateco (sur *Fellhanera bouteillei*, esceptokaze sur *Bacidina* sp.), fiksivaj hifoj ne tre videblaj, malpli longaj, pli maldikaj k distingeble pli helkoloraj, k disvastiĝo (Eŭropo, Azio k S–Ameriko). Evidentigo de rudimentaj perifizoj ĉe *Wentiomyces lichenicola*.

Abstract

Wentiomyces lichenicola (Hansf.) D. Hawksw. subsp. *bouteillei* Bricaud, Roux et Sérusiaux subsp. nov. differs from subsp. *lichenicola* by parasitic specificity (on *Fellhanera bouteillei* exceptionnally on *Bacidina* sp.), its anchoring hyphae that are hardly visible, shorter, thiner and distinctly paler, and its distribution (Europa, Asia and South America). Observation of rudimentay periphyses in *Wentiomyces lichenicola*.

Introduction

Hawksworth (1980: 385) a décrit très brièvement *Wentiomyces lichenicola* (Hansf.) D. Hawksw., un champignon lichénicole non lichénisé, connu seulement par les spécimiens originaux récoltés en Ouganda (Afrique orientale), sur le thalle d'un lichen foliicole non déterminé par l'auteur. La description de cette espèce a été reprise sans modification par Clauzade et al. (1989).

Dans sa thèse sur les lichens épiphytes de Navarre, Etayo (1989) mentionne un *Wentiomyces* cf. *lichenicola* s'établissant sur le thalle de *Fellhanera bouteillei* (Desm.) Vĕzda, rarement sur celui de *Parmelia caperata* (L.) Ach. Tout récemment, deux des auteurs du présent travail (O. Bricaud et C. Coste) trouvaient, dans le Gard et les Pyrénées-Atlantiques, sur le thalle, ou même sur les apothécies en mauvais état de *Fellhanera bouteillei*, un *Wentiomyces* qu'ils attribuaient tout d'abord, avec C. Roux, à *Wentiomyces lichenicola*, car le matériel récolté ne présentait aucune différence avec la description de *Wentiomyces lichenicola* donnée par Hawksworth (loc. cit.).

Toutefois, en raison de la brièveté de cette description, l'un de nous (C. Roux), aidé par O. Bricaud et E. Sérusiaux, a fait une étude comparative du matériel type de *W. lichenicola* (IMI) et du *W.* cf. *lichenicola* européen. À l'issue de cette étude, il est apparu que le *W.* cf. *lichenicola* européen —à l'exclusion du matériel sur *Parmelia caperata,* qui n'appartient pas au genre *Wentiomyces* —diffère du *W. lichenicola* s. str. par des caractères peu importants mais constants, si bien que nous le décrivons ci-après comme une nouvelle sous-espèce: *W. lichenicola* subsp. *bouteillei* Bricaud, Roux et Sérusiaux subsp. nov.

Fig. 1 — *Wentiomyces lichenicola* subsp. *bouteillei* (holotype). Périthèce observé dans l'eau, vu de dessus, montrant les cellules polygonales du péridium (*textura angularis*), l'ostiole, les poils ramifiés dichotomiquement et les hyphes végétatives (vers le bas, plus fins que les poils).

Diagnose

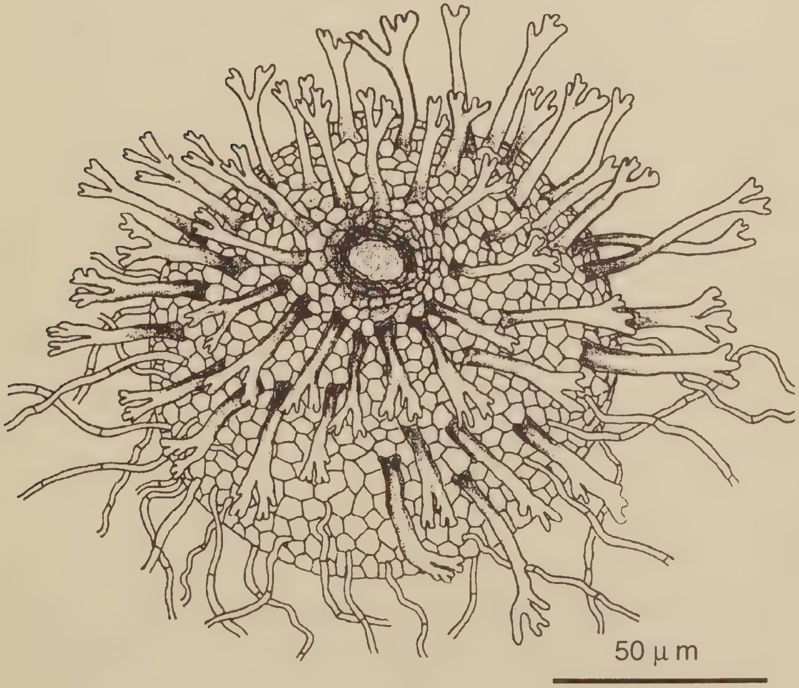
1 – En latin

Differt a *Wentiomyce lichenicola* (Hansf.) D. Hawksw. subsp. *lichenicola* hyphis detinentibus perithecia parum conspicuis, brevioribus (50–100 µm), angustior ibus (2–3 µm diametro in basi) et pallidioribus (pallidofuscis) et quia vivit in *Fellhanera bouteillei* (Desm.) Vězda rarissime in *Bacidina* sp.

Holotypus in herbario C. Roux (MARSSJ n° 21315) : Gard, Méjannes–le–Clap, alt. 300 m, in caverna "Trois–Trous", in thallis *Fellhanerae bouteillei*, in foliis *Buxi sempervirentis*, leg. O. Bricaud 1992/10/04. Isotypus : in herbario O. Bricaud.

2 – En langue internationale (espéranto)

Diferencas de *Wentiomyces lichenicola* (Hansf.) D. Hawksw. subsp. *lichenicola* pro periteciaj fikshifoj ne tre videblaj, pli mallongaj



(50–100 µm), pli maldikaj (ĉebaze 2–3 µm diametraj) kaj pli helkoloraj (helege aŭ hele brunaj) kaj pro specifa loĝateco (ĉe *Fellhanera bouteillei*, esceptokaze ĉe *Bacidina* sp.).

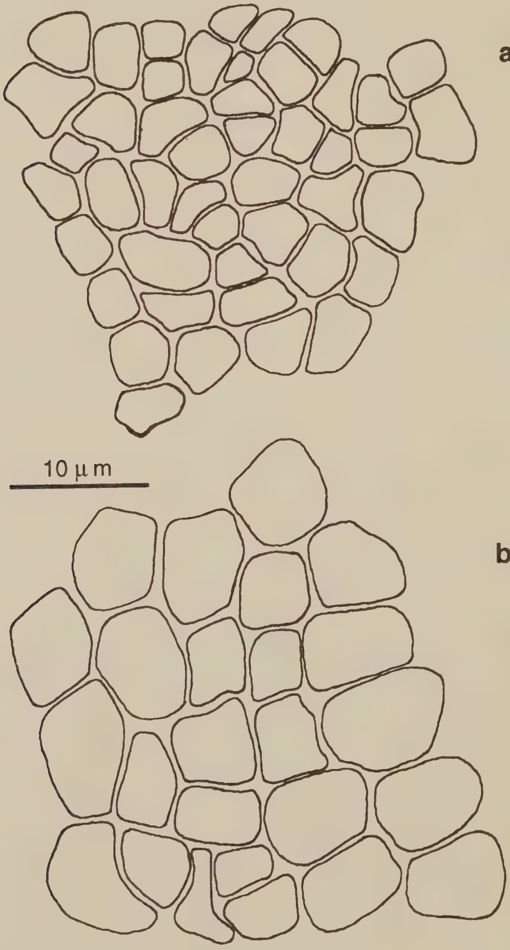


Fig. 2— *Wentiomyces lichenicola* subsp. *bouteillei* (holotype). Cellules du péridium d'après un écrasement de périthèce (vue tangentielle). a) couche externe ; b) couche interne.

Holotipo: en herbario C. Roux, MARSSJ: Gard, Méjannes-le-Clap, alt. 300 m, en kaverno Trois-Trous, 22 m profonde, sur taloj de *Fellhanera bouteillei,* sur folioj de *Buxus sempervirens,* kolektis O. Bricaud 1992/10/04. Izotipo: en herbario O. Bricaud.

Description

Une description sommaire de *Wentiomyces lichenicola* subsp. *bouteillei* Bricaud, Roux et Sérusiaux subsp. nov. (sous le nom de *W.* cf. *lichenicola*) a été déjà été publiée par Bricaud et al. (1993).

1 – Ascomes (périthèces)

Périthèces (fig. 1) assez petits, de (40)100–200 µm de diamètre (y compris les poils périthéciaux), isolés, sessiles sur le thalle ou même les apothécies en mauvais état de *Fellhanera bouteillei*, exceptionnellement sur le thalle d'un *Bacidina* stérile, noirâtres, globuleux, à ostiole apical, hérissés de poils, ancrés au thalle de l'hôte par des hyphes fixatrices non ou peu visibles au stéréomicroscope mais bien visibles au microscope à transmission .

Paroi des périthèces (fig. 2 et fig. 3) pseudoparenchymateuse (= paraplectenchymateuse), à *textura angularis*, le plus souvent formée de 2 couches de cellules pigmentées (parfois 3 dans la région ostiolaire, parfois une seule dans la région basale).

Sur une vue tangentielle (fig. 2), par exemple sur un écrasement de périthèce, ces cellules apparaissent isodiamétriques ou peu allongées. La couche externe est formée de cellules (à lumière de 3–7 x 2–4 µm) plus petites que celles de l'interne (lumière de 5–10 x 3–7 µm), et les deux types de cellules présentent une paroi mince (0,5–1 µm), pigmentée de brun sombre (pigment dissous dans la paroi), percée de nombreux pores ("Munkporen" des auteurs germaniques).

Sur une coupe transversale (fig. 3), les cellules de la paroi apparaissent subrectangulaires (lumières de 3–10 x 1–4 µm). Autour de l'ostiole du périthèce adulte, surtout dans sa partie externe, la paroi des cellules s'épaissit sensiblement (1–2 µm) et leur lumière a tendance à devenir plus étroite.

La paroi proprement dite, pigmentée, est doublée intérieurement de 2 à 3 couches de cellules incolores, assez lâches.

Poils (fig. 4) situés sur la moitié supérieure des périthèces, dressés, brun sombre, cloisonnés transversalement, de 40–65 µm de longueur, rigides, ramifiés dichotomiquement deux ou trois fois au sommet, à paroi épaisse mais amincie au sommet. Dans la zone équatoriale des périthèces, on rencontre parfois des formes de transition entre ces poils et les hyphes fixatrices (§5).

Ostiole bien visible au microscope (fig. 1 et fig. 3), apical, comprenant de l'extérieur vers l'intérieur :

- Une membrane à structure pseudoparenchymateuse, qui ferme le canal ostiolaire avant l'éjection des spores, semblable à celle du reste de la couche supérieure de la paroi périthéciale mais à cellules plus petites (lumières de 2,5–4 x 2–3,5 µm, vue de dessus) et à paroi nettement plus mince (< 0,5 µm).
- Un canal ostiolaire, très court.
- À la partie supérieure de ce dernier, deux couches de cellules en forme de papilles qui constituent une sorte de couronne (fig. 5). Ce sont des périphyses rudimentaires, courtes (4–10 x 2–3 µm), très

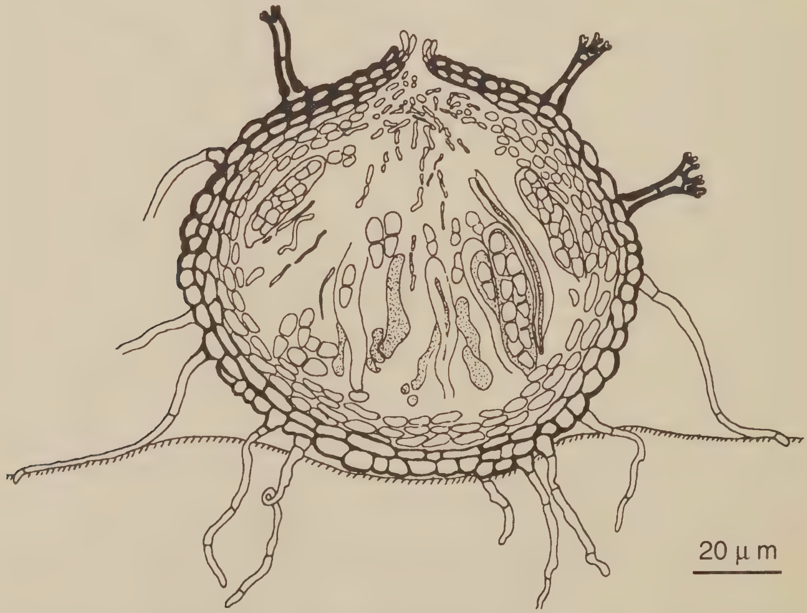


Fig. 3 — *Wentiomyces lichenicola* subsp. *bouteillei* (Gard, Goudargues, herbier C. Roux, MARSSJ n° 21527). Coupe transversale radiale d'un périthèce adulte colorée par le bleu de lactophénol, montrant la paroi (péridium) portant les poils périthéciaux et les hyphes végétatives, présentant, au sommet de l'ostiole, des cellules modifiées formant la couronne périostiolaire et contenant des asques à divers stades de leur développement ainsi que des restes de paraphysoïdes (notamment dans la partie supéro–axiale).

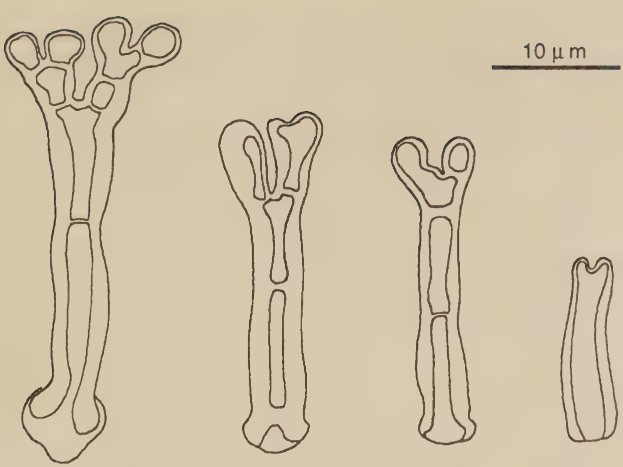


Fig. 4 — *Wentiomyces lichenicola* subsp. *bouteillei* (holotype). Poils périthéciaux à divers stades de développement.

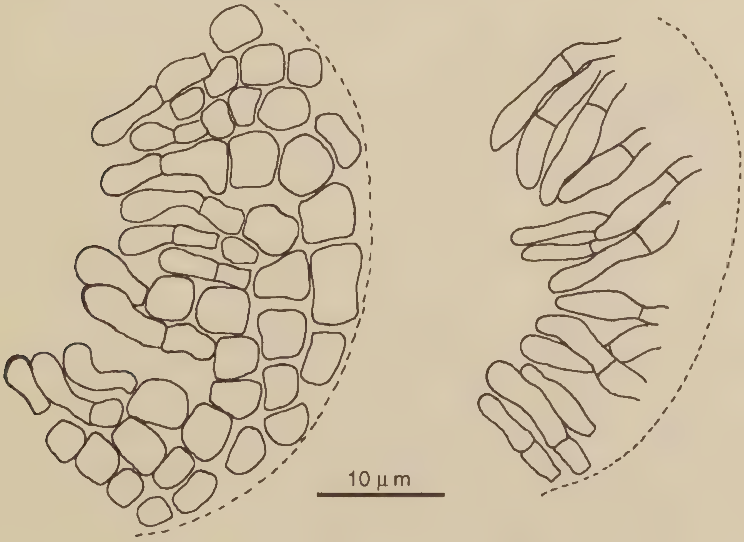
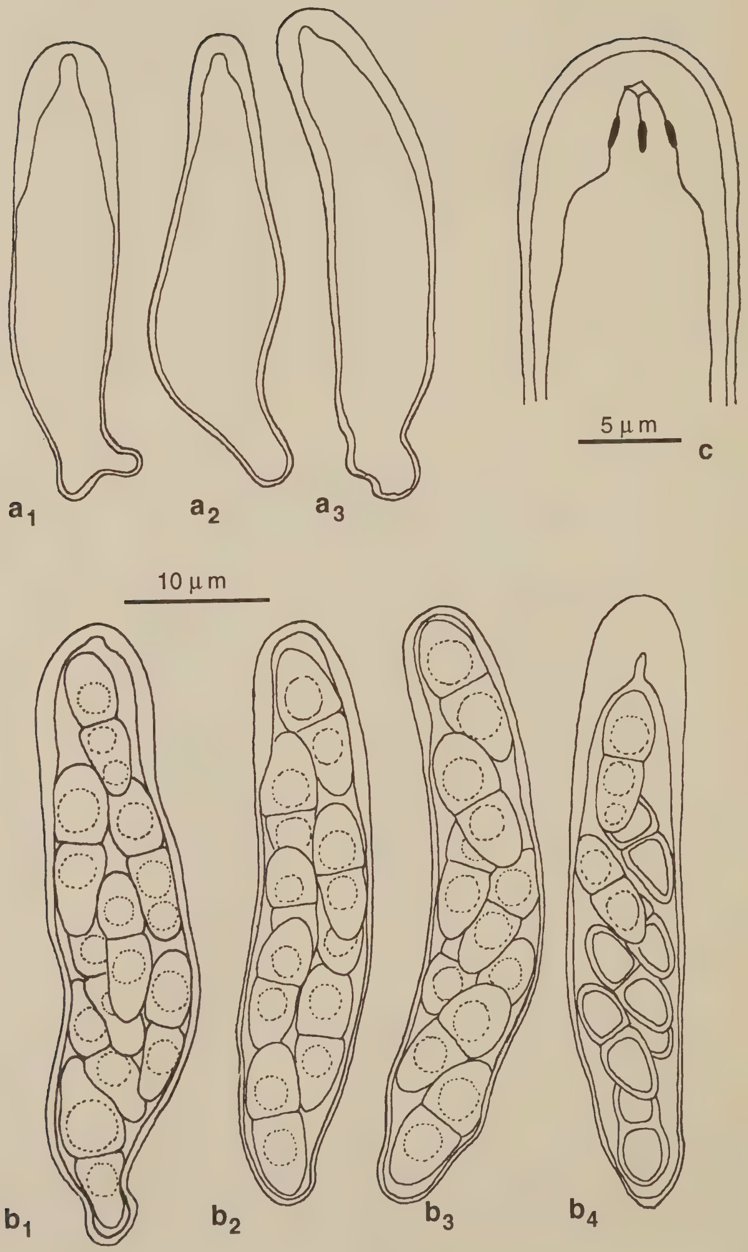


Fig. 5 — *Wentiomyces lichenicola* subsp. *bouteillei* (Gard, Goudargues, herbier C. Roux, MARSSJ n° 21527). Détail partiel des paraphyses rudimentaires garnissant l'ostiole, d'après l'examen d'une calotte supérieure de périthèce montée dans l'eau. a) Couche supérieure ; b) couche inférieure. En pointillé, contour de l'ostiole.


a_1
a_2
a_3
5 µm
c
10 µm
b_1
b_2
b_3
b_4

légèrementpigmentées (brun jaune pâle ou très pâle), qui présentent parfois, à leur extrémité distale, une calotte pigmentaire brune. Issues de la couche externe (sombre) de la paroi périthéciale, elles correspondent aux "périphyses de la formation externe" de Janex (1971 : 439–440), définies antérieurement par Chadefaud et Avellanas (1967) et Parguey– Leduc (1967).

À notre connaissance, des périphyses ne semblent pas avoir été mentionnées chez les *Wentiomyces* (en particulier ni par Hawksworth 1980 ni par Müller et Arx 1962), probablement car elles s'observent difficilement sur une coupe axiale, mais assez bien sur une calotte supérieure de périthèce vue de l'intérieur ou sur un écrasement modéré d'une moitié supérieure de périthèce.

De telles périphyses rudimentaires ne sont pas particulières au genre *Wentiomyces* puisque l'un de nous (C. R.) les a observées également chez plusieurs espèces de *Stigmidium* (travail en cours avec D. Triebel). Elle ont très vraisemblablement pour rôle de régler l'ouverture et la fermeture de l'ostiole lorsque, à maturité, la membrane supérieure de l'ostiole a disparu.

2 – Hamathécium

Constitué par des périphyses rudimentaires (voir ci–dessus) et des paraphysoïdes ordinairement peu ou pas visibles car disparaissant précocement. Chez le périthèce adulte, les restes de paraphysoïdes ne sont guère visibles qu'après coloration, par exemple par le bleu de lactophénol (fig. 3).

3 – Asques

Asques (fig. 6) claviformes ou subcylindriques, de (35)39–50 x 7–11µm, octosporés, fissituniqués, à sommet épaissi (tholus) et creusé

Fig. 6— *Wentiomyces lichenicola* subsp. *bouteillei*. Asques immatures (a) et matures (b), octosporés (tous observés dans l'eau, le premier en partant de la droite après traitement par l'hydroxyde de potassium qui épaissit le tholus et rend la chambre oculaire plus petite mais mieux délimitée). c) Détail du sommet ascal observé dans le bleu de crésyl (solution aqueuse à 0,1 %), montrant la chambre oculaire et la nasse apicale qui apparaît comme une différenciation de l'endoascus (3 baguettes verticales sur les 4 ont été représentées). a_1 : holotype ; a_2 et a_3 : Pyrénées–Atlantiques, Laruns, herbier C. Coste ; b_1 : Sivergues, herbier O. Bricaud ; b_{2-4} : holotype ; c : Vaucluse, Sivergues, herbier O. Bricaud.

d'une chambre oculaire (surtout visible chez les jeunes asques ou après traitement des asques mûrs par K), contenant une nasse apicale (surtout visible après coloration par le bleu de crésyl: fig. 6c), à paroi I– (même après pré–traitement par K), à ascoplasme I+ (rouge vineux), à pédoncule très court ou nul et à pied bilobé, souvent peu nettement, large.

4 – Spores

Spores (fig. 7) par 8, bisériées dans les asques, plus rarement presque unisériées (herbier Etayo 2939), incolores, de (9,5)10,5–*12,1*–14,5(16) x (2,5)4–*4,4*–5(6) µm, à rapport longueur sur largeur de (1,8)2,2–*2,8*–3,5(4,0) [n = 58 spores], uniseptées, légèrement ou même

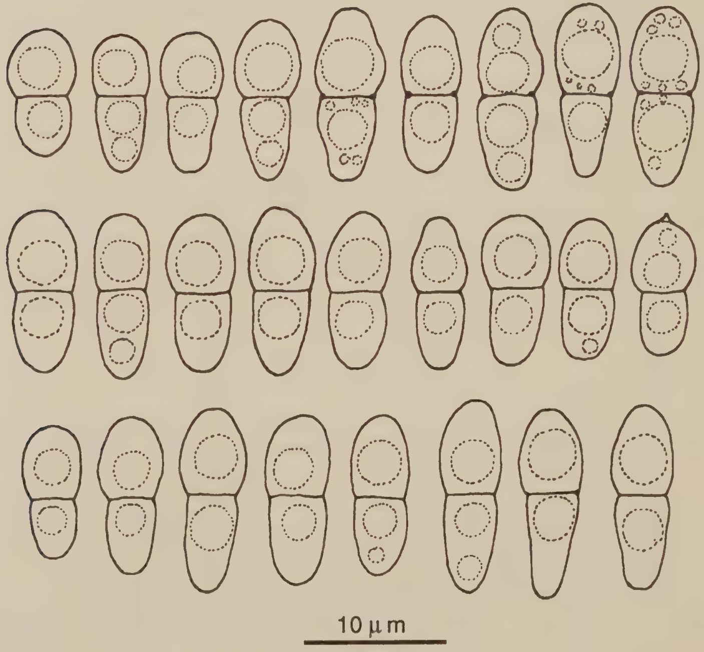
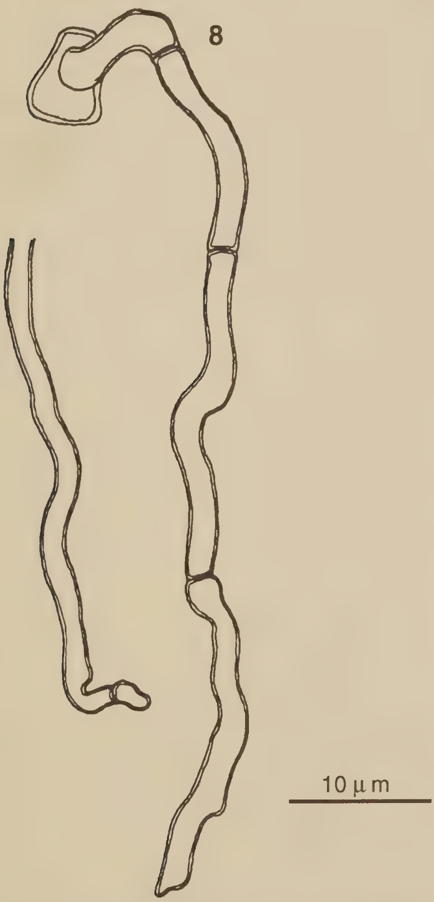


Fig. 7 — *Wentiomyces lichenicola* subsp. *bouteillei*. Spores vivantes observées dans le bleu de crésyl (solution aqueuse à 0,1 %). En haut, Vaucluse, Sivergues (herbier O. BRICAUD) ; torus parfois visible (à droite). Au milieu, Gard, Méjannes–le–Clap (holotype). En bas, Pyrénées–Atlantiques, Laruns, herbier C. COSTE.

nettement rétrécies au niveau de la cloison, parfois aussi légèrement rétrécies au milieu de chaque cellule, contenant 1 ou 2 guttules dans chaque cellule, dépourvues de halo, mais présentant parfois une calotte gélatineuse, très peu visible, à chaque extrémité. Sur le matériel frais, le bleu de crésyl fait apparaître un torus équatorial coloré en bleu (fig. 7, en haut et à droite) comme la cloison.



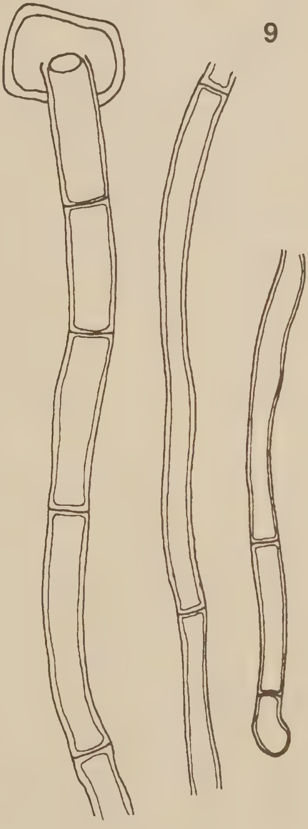


Fig. 8— *Wentiomyces lichenicola* subsp. *bouteillei* (holotype). Hyphes d'ancrage. a) Hyphe relativement courte, entière, issue d'une cellule du péridium. b) Extrémité distale d'un autre hyphe, plus long.
Fig. 9— *Wentiomyces lichenicola* subsp. *lichenicola* (syntype). Hyphes d'ancrage (base, milieu et extrémité distale).

5 – Hyphes végétatives

La moitié inférieure des périthèces porte des hyphes d'un brun pâle ou assez clair, d'environ 50–100 µm de long et de (1,5)2–3 µm de diamètre, à paroi mince et à cloisons peu nombreuses (fig. 1, 3 et 8). Cependant, MATZER, qui a également étudié des spécimens de *W. lichenicola* subsp. *bouteillei*, nous signale (*in litt.*) que les hyphes fixatrices peuvent être incolores et atteignent parfois 130 µm de longueur et 4 µm de diamètre.

Les hyphes supérieures, issues de la partie libre des périthèces, sont essentiellement obliques et horizontales et pénètrent peu profondément dans le thalle : elles ont probablement un rôle essentiellement fixateur, et on peut les qualifier d'hyphes d'ancrage. Au contraire, les hyphes issues de la partie la plus basale des périthèces, en contact avec le thalle de l'hôte, s'enfoncent rapidement dans celui–ci (fig. 3) pour atteindre la couche algale : outre un rôle fixateur, elles ont vraisemblablement une fonction surtout nutritive.

Répartition — Écologie

Jusqu'ici, nous avons rencontré *Wentiomyces lichenicola* subsp. *bouteillei* en Espagne (Catalogne, Navarre) et en France méridionale (Aveyron, Gard, Pyrénées–Atlantiques, Vaucluse). De plus, l'un de nous (SÉRUSIAUX) a observé des échantillons d'herbier récoltés dans le bassin parisien (Val–d'Oise) par BOUTEILLE (voir ci–après), mais aucune récolte récente n'a été effectuée dans cette région. Enfin MATZER (*in litt.*) a observé des spécimens de *W. lichenicola* subsp. *bouteillei* d'Asie et d'Amérique du Sud, dont il précisera la localisation dans une publication ultérieure.

W. lichenicola subsp. *bouteillei* se rencontre presque exclusivement sur le thalle de *Fellhanera bouteillei*, exceptionnellement sur thalles stériles d'un *Bacidina*, lichens sur lesquels il ne provoque aucun dégât visible, ni macroscopiquement ni microscopiquement : c'est donc, selon toute vraisemblance un parasymbiote.

Dans le sud de la France, la sous–espèce se rencontre dans d'assez nombreuses stations de *Fellhanera bouteillei*, sur feuilles de *Buxus sempervirens*, dans le fond de vallons humides soumis à des rosées abondantes et fréquentes. Dans l'ensemble de son aire européenne, *W. lichenicola* subsp. *bouteillei* se rencontre entre 240 et 600 m d'altitude, aux étages mésoméditerranéen et collinéen, sous un ombroclimat humide.

Affinités

Wentiomyces lichenicola subsp. *bouteillei* est extrêmement voisin de *W. lichenicola* subsp. *lichenicola*, dont elle ne diffère que par l'identité de l'hôte, par la longueur, l'épaisseur et la couleur des hyphes fixatrices, ainsi que par la répartition géographique (fig. 8 et tableau).

Nous avons étudié dans le détail le matériel type (syntype) de *Wentiomyces lichenicola* sensu stricto (IMI), qui, rappelons le, provient d'Ouganda (Afrique orientale). Il est réparti sur 4 feuilles d'*Acalypha fruticosa* portant divers champignons foliicoles, la plupart non lichénisés. *Wentiomyces lichenicola* subsp. *lichenicola* se rencontre exclusivement sur les thalles du lichen *Asterothyrium leucophthalmum* (Müll. Arg.) R. Sant.

Nous avons hésité sur le statut taxonomique de *W. lichenicola* subsp. *bouteillei*: fallait–il le considérer comme une espèce autonome ou comme une sous–espèce de *W. lichenicola*?

Quelques arguments plaident en faveur de la première hypothèse: l'étude de nombreuses collections du matériel européen nous a montré que les différences avec le matériel africain, aussi bien morphologiques (filaments fixateurs) que biologiques (hôte), sont constantes (deux spécimen de la subsp. *bouteillei* ont cependant été trouvés sur thalles stériles de *Bacidina* sp., dans la même station); en outre, les deux taxons ont une aire de répartition bien différente.

	subsp. *lichenicola*	subsp. *bouteillei*
Hyphes d'ancrage	Bien visibles au stéréomicroscope (x 50), nombreuses, rayonnantes, de 80-250 µm de long, d'un brun assez sombre, de 3-4 µm de diamètre dans leur tiers basal	Peu ou pas visibles au stéréomicroscope (x 50), non distinctement rayonnantes, de 50-130 µm de long incolores, brun pâle ou brun clair, de 2-3(4) µm de diamètre dans leur tiers basal
Hôte	*Asterothyrium leucophthalmum*	*Fellhanera bouteillei*, exceptionellement thalles stériles de *Bacidina* sp.
Répartition	Afrique orientale (Ouganda)	Europe (surtout méridionale), Asie et Amérique du Sud

Tableau: Caractères distinctifs entre les deux sous–espèces de *Wentiomyces lichenicola*.

Toutefois, les caractères morphologiques séparant les deux taxons (hyphes d'ancrage plus longues, plus sombres et généralement plus épaisses chez la sous-espèce type) sont peu importants. Ils résultent probablement d'une évolution divergente du fait d'un hôte ou d'un milieu différent. Par ailleurs, *W. lichenicola* subsp. *lichenicola* n'est connu que de collection type (4 spécimens provenant d'une même récolte) : la spécificité parasitaire du matériel africain n'est donc pas certaine.

C'est pourquoi il nous semble préférable de considérer le matériel européen —et, selon toute vraisemblance, également le matériel asiatique et sud-américain— comme une sous-espèce de *Wentiomyces lichenicola* : les deux taxons ne diffèrent que par des caractères morphologiques mineurs, par leur spécificité parasitaire (probable mais non certaine) et par leur répartition géographique, critères qui correspondent bien à la notion de sous-espèce. En effet, malgré l'important matériel de *Fellhanera bouteillei* examiné en provenance de toutes les régions du monde par l'un de nous (E. S.) et par MATZER (*in litt.*), *W. lichenicola* subsp. *bouteillei* n'a pas été observé en Afrique, où seule la subsp. *lichenicola* est connue.

Par ailleurs, HAWKSWORTH (1980) a décrit une nouvelle espèce, sur le thalle de *Peltigera leucophebia* (Nyl.) Gyeln., *Wentiomyces peltigericola* D. Hawksw., qui diffère nettement de *W. lichenicola*, ainsi que des autres *Wentiomyces* non lichénicoles (voir par exemple MÜLLER et ARX 1962), par ses poils périthéciaux simples.

Spécimens examinés

Note : les dates sont indiquées selon le système international : an / mois / jour.

1 – *Wentiomyces lichenicola* (Hansf.) D. Hawksw. subsp. *lichenicola* (Syntype)

Uganda, Kiagwe, Mukono, on lichens on leaves of *Acalypha fruticosa*, G. HANSFORD 2977 (IMI 5725, syntype !). Spécimen sans date de récolte (*Proc. Linn. Soc. London* **157** : 186, 1946).

Observations : périthèces de (50)100–150 µm de diamètre (y compris les poils périthéciaux), munis de périphyses identiques à celle de *Wentiomyces lichenicola* subsp. *bouteillei*, asques de 34–47 x 11–13 µm, spores de 12–15,5 x 3,5–5 µm (n =10), la plupart avec 2 guttules dans chaque cellule.

2 – *Wentiomyces lichenicola* subsp. *bouteillei* Bricaud, Roux et Sérusiaux

Sauf indication contraire, observé sur thalles de *Fellhanera bouteillei* sur feuilles de *Buxus sempervirens*.

a) Espagne

- Navarre, Aoiz, Poche de Chinchurrinea, U.T.M. 30TXN3344, alt. 550 m, 1987/06/12, J. Etayo 2939 (herbier J. Etayo).
- Navarre, Usún, Foz de Arbayun, 30TXN4827, alt. 500 m, sur thalles stériles de *Bacidina* sp., sur feuilles de *Buxus sempervirens*, 1991/07/21, J. Etayo 2073 et P. Diederich (herbier J. Etayo).
- Navarre, Usún, Foz de Arbayun, sur thalle de *Bacidina* cf. *vasakii*, 1991/07/12, E. Sérusiaux, récolté avec J. Etayo, P. James et F. Rose (LG).
- Catalogne, Girona, Oix, alt. 500 m, 1991/11, J. Etayo 5278 (herbier J. Etayo).
- Catalogne, Girona, Oix, alt. 500 m, 1991/02, P. Diederich (herbier P. Diederich).

b) France

- Aveyron, gorges du Lot, carrefour des routes vers Issac et vers Florentin–la–Capelle, 1986/08, E. Sérusiaux (LG).
- Gard
  - Commune de Méjannes–le–Clap, alt. 300 m, dans l'aven des Trois–Trous, à 22 m de profondeur, 1992/10/04, O. Bricaud [herbier O. Bricaud (*Isotypus*) et herbier C. Roux, MARSSJ n° 21315 (*Holotypus*)].
  - Commune de Goudargue, vallon d'Ussel, alt. 240 m, sur thalles et apothécies de *Fellhanera bouteillei*, 1992/04/11, C. Roux (herbier C. Roux, MARSSJ n° 21527).
- Pyrénées–Atlantiques
  - Commune de Laruns, Mourat, alt. 600 m, 1992/04/01, A. Royaud (herbier C. Coste et herbier C. Roux MARSSJ n° 21287).
  - Commune de Sauveterre–de–Béarn, île sur le gave d'Oloron, 1985/07, E. Sérusiaux n° 7508 p. p. (LG).
  - Commune de Sainte–Engrâce, gorges d'Ujarre, 1991/07, P. Diederich et J. Etayo (herbier P. Diederich).
- Val–d'Oise (ex Seine–et–Oise p. p.), commune de Magny–en–Vexin, Bouteille, (UPS, herbier Schaer.).
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MISCELLANEOUS NOTES ON MUCORACEAE

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ABSTRACT: Three new species of the zygomycete genera *Mucor* and *Rhizopus* are described. *M. nanus* sp. nov. is characterized by small-sized sporangia and extremely slowly growing colonies; it resembles some species of *Absidia*. *M. grandis*, sp. nov., resembles *M. oblongisporus* Naumov, but differs from it by taller sporangiophores, larger sporangia and columellae of a slightly different shape and larger sporangiospores. In addition, it has a higher temperature requirement. *Rh. caespitosus*, sp. nov. belongs to the *Rh. microsporus* complex close to *Rh. microsporus* var. *microsporus*, but is distinct by short sporangiophores in groups of up to 9 and smooth sporangiospores. Furthermore it can grow at 50°C.

New acquisitions of five strains of *M. variosporus*, which had only been known from its type culture from India, are discussed. Zygospores were obtained and the mating reactions of the strains are given. *Mucor faisalabadensis* Mirza et al. takes an intermediate position between *Mucor* and *Absidia*, and the new genus *Protomycocladus* is proposed. Its apophysate pyriform sporangia are similar to taxa of the genus *Absidia*. However, sporangiophores which arise directly from the substrate, absence of stolons and rhizoids and distinctly stellate zygospores are characteristic of *Mucor*.

INTRODUCTION

Over a number of years, some isolates were received which are considered to be different from the known species of *Mucor* and *Rhizopus* as accepted by Schipper (1973, 1975, 1976, 1978 and 1984) and Schipper and Stalpers (1984). In the present paper three new taxa are proposed for these isolates. In addition the type culture of *Mucor faisalabadensis* was examined and the taxonomic position is discussed.

MATERIAL AND METHODS

Colonies were grown in glass Petri dishes as described by Schipper (1973) and tall species in 80 mm high dishes to allow undisturbed development. Unless otherwise indicated, cultures were grown in the dark. The media used were cornmeal, cherry decoction, 2% and 4% malt extract, oatmeal, potato-carrot, potato-dextrose and V8-juice agars.

For the examination and measurements of the various structures distilled water was used for the preparation of slides. The branching and the height of the sporangiophores were examined and measured by a dissecting microscope.

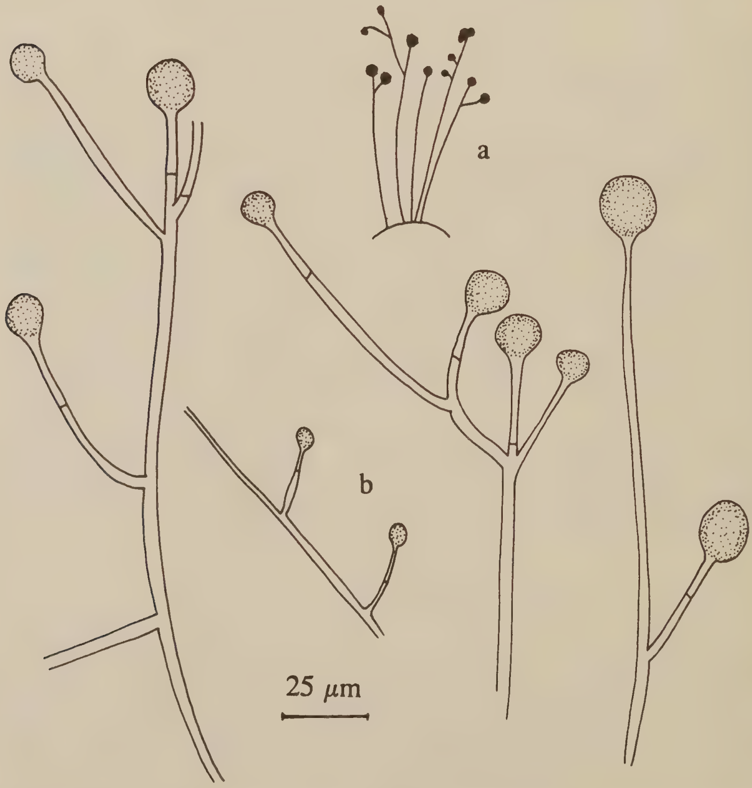

Fig. 1. *Mucor nanus* (CBS 774.86) a-b. branching pattern of sporangiophores (a. schematic)

Mucor nanus Schipper & Samson, sp. nov. — Figs. 1-2.

Coloniae in agaro maltoso 25°C dilute brunneae, sporangiophora ad 8 μm diam, irregulariter ramosa; sporangia brunnea, ad 50 μm diam, paries deliquescens et translucens; columellae subglobosae, ad 21 μm diam, collari minutissimo vel nullo circumdatae; sporangiosporae ellipsoideae, 1.5-2 x 1 μm; zygosporae ignotae. Crescit et sporulat temperaturis inter 12 et 30°C.
Typus vivus et exsiccatus: CBS 774.86, isolatus e terra piceeti in Suecia a B.E. Söderström.

Colonies growing extremely slowly, attaining a diameter of up to 1 cm within 14 days, low, at first white, soon becoming deep olive-buff. Sporangiophores arising from substrate hyphae, branching in a mixed fashion, up to 1 mm tall and 8 μm wide. Sporangia globose, up to 25(-50) μm diam, brownish transparent, non apophysate, with a globose or slightly applanate-globose columella up to 21 μm diam, collar absent or minimal; sporangiospores smooth-walled, hyaline, ellipsoidal 1.5-2 x 1 μm. Zygospores unknown.

Growth and sporulation occurring between 12 and 30°C, optimal between 27-30°C. The various media have no influence on growth and sporulation at 25°C.

Isolates examined:
CBS 774.86, type culture, and CBS 775.86, both isolated from coniferous soil in Sweden by B.E. Söderström.

M. nanus is not a typical species of *Mucor* because of its extremely slow growth. It is here placed in *Mucor* on the basis of the structure of the sporangiophores and sporangia. The species resembles *Absidia zychae* Hesseltine & J.J. Ellis, which has sporangiophores arising either from stolons or from surface or submerged hyphae and pyriform and globose sporangia. It therefore represents an intermediate between *Absidia* and *Mucor*. *M. nanus* definitely belongs to *Mucor*, because it differs from typical species of *Absidia* by the absence of stolons and by globose sporangia. The wider temperature range and high optimum for growth are unusual.

In view of the small size of the sporulating structures, the name *Mucor nanus* is proposed. Extremely slow growth in pure culture of isolates of Zygomycetes may indicate a xerophilic or mycoparasitic nature (cf. *Absidia parricida* Renner & Muskat,

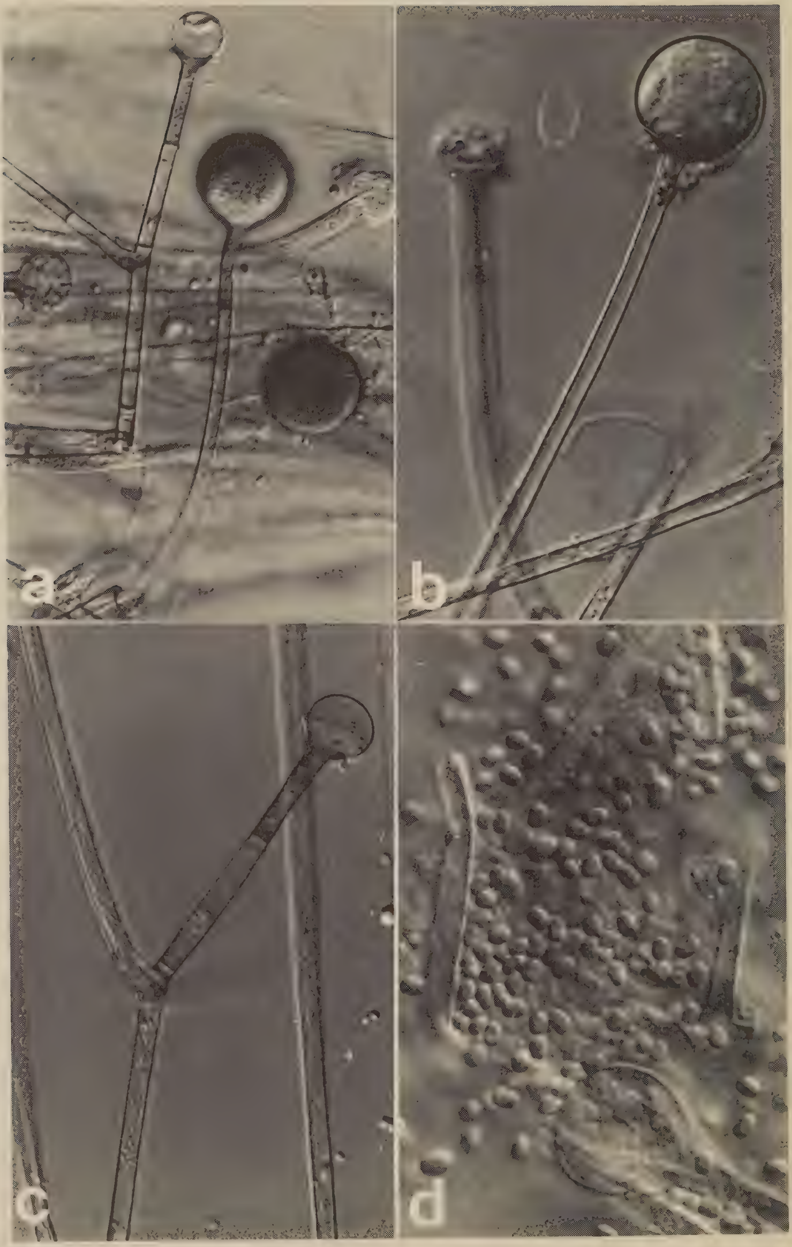
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Fig. 2 *Mucor nanus*, light micrographs. a-c. sporangiophores and sporangia a. x 540, b. x 660, c. x 620, d. spores, x 1520.

A. verticillata (Beauvérie) Lendner). Cultivation of the type culture on low water activity media including malt extract agar with 20 % sugar, showed no improved growth. Furthermore, no reactions of mycoparasitism were observed in mixed cultures with other Zygomycetes or with *Botrytis cinerea* Pers.

Mucor grandis Schipper & Samson, sp. nov. — Figs. 3-4.

Coloniae in agaro maltoso 24°C olivaceo-griseae; sporangiophora 45 µm diam, primum curvata, deinde recta, plerumque simplicia; sporangia pallide brunnea ad 250 µm diam; columellae conicae vel ellipsoideae, ad 200 x 180 µm, collari minutissimo circumdatae; sporangiosporae ellipsoideae, 12.5-21 x 7.5-12 µm; zygosporae ignotae. Crescit et sporulat temperaturis inter 21 et 36°C.
Typus vivus et exsiccatus CBS 186.87, isolatus ex excrementis muris a P. C. Misra, Gorakhpur, India.

Grown on malt extract agar at 24°C reaching the lid (80 mm) and filling the plate (90 mm) in four days, loosely structured, clearly showing the substrate hyphae. At first white soon becoming olive buff; reverse yellowish, odour aromatic. Sporangiophores rather firm, though occasionally collapsing and producing marginal colonies, 40-50 µm diam, sometimes coiled, mostly unbranched or infrequently branched, with a few small droplets occurring on the sporangiophore surface. Young sporangiophores erect, but recurving during development of the sporangia and straightening again after maturation. Sporangia pale brownish to yellow, moist to dry, finely echinulate, globose to slightly applanate, up to 250(-300) µm diam in dry conditions, columella conical to cylindrical-ellipsoidal, 115-200 x 100-180 µm, with or without brownish contents; collar mainly consisting of a row of short spines, not very distinct. Sporangiospores narrow ellipsoidal with rounded ends, unequal in size, 12.5-21 x 7.5-12 µm, smooth-walled, hyaline, with greyish yellow, cloudy to granular contents.

Temperature requirements: at 17°, in daylight, a bright orange, but poorly developed colony was produced; between 21 and 36°C good development when grown in darkness; at 40° slight, atypical growth, no sporulation; at 45° no growth.

Mating experiments on malt extract agar at 25 °C:
The type isolate CBS 186.87 was mated with the following species: *Mucor recurvus*, CBS 195.71 (+) and *Backusella circina*, CBS 128.70 (+), which both resulted in incomplete conjugations. The mating with *Mucor prayagensis*, CBS 816.70 (+) showed only a deep salmon-yellow colouring, which could indicate a weak reaction. These reactions determine the mating type of CBS 186.87 as (-). The only available strain of *M. oblongisporus*, CBS 569.70, also has a (-) reaction, and so a possible compatibility between these taxa could not be tested (see discussion below).

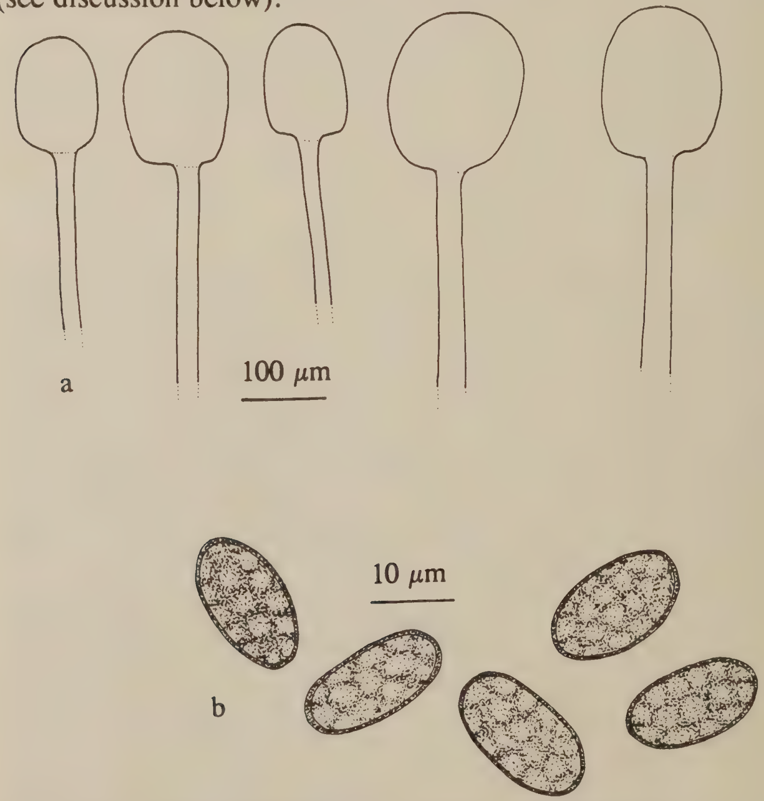
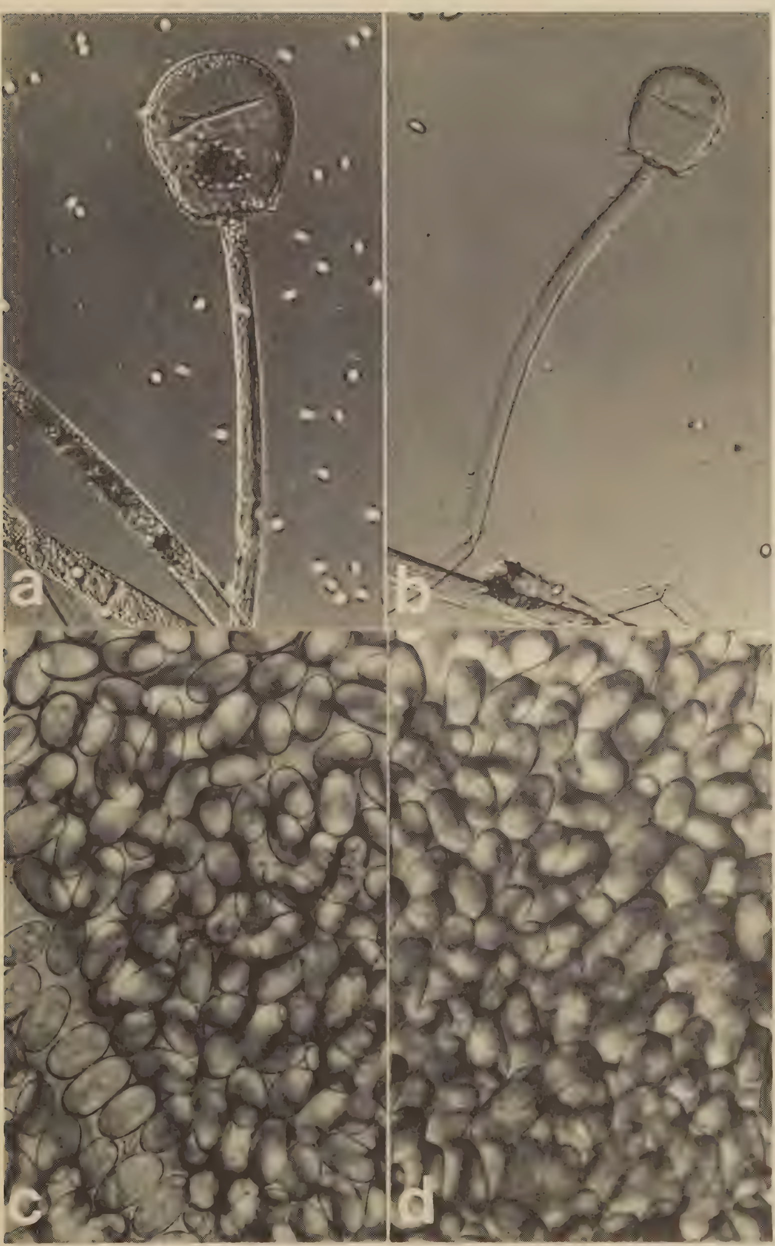


Fig. 3. *Mucor grandis* (CBS 186.87) a. Columellae, b. sporangiospores.
Fig. 4. *Mucor grandis*, light micrographs. a-b. sporangiophores, x 150, c-d. sporangiospores, x 600.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Material examined: CBS 186.87 = P.C.M. 608, ex mouse dung, Gorakhpur, U.P. India, sent by P.C. Misra, Department of Botany, University of Gorakhpur, India, in 1977.

M. grandis belongs to the tall *Mucor* species revised by Schipper (1978) and is most closely related to *M. oblongisporus* Naumov sensu Naganishi, Hirahara & Joshita (CBS 569.70, neotype). It differs from *M. oblongisporus* in the production of taller sporangiophores, with larger sporangia and columellae of a slightly different shape and larger sporangiospores. In addition it has higher temperature requirements. Recently Chen and Zheng (1980) also described a species with tall sporangiophores and spores as *M. gigasporus*. The type culture (CBS 566.91) differs from *M. grandis* by the irregularly shaped sporangiospores of up to 30 μm, which are borne in relatively small (up to 90 μm diam) sporangia with globose columellae.

M. grandis and *M. nanus* can be identified by using the key given by Schipper (1978: 48-52). *M. nanus* would fit ad 4: sporangiospores 1.5-2.0 x 1 μm, hyaline and ellipsoidal; *M. grandis* ad 46: sporangiospores narrow ellipsoidal, up to 21 μm in length.

Rhizopus caespitosus Schipper & Samson, sp.nov. — Fig. 5-6.

Coloniae in agaro farina avenae confecto 30°C pallide griseae; sporangiophora 1-9 aggregata, ad 10 μm diam, 200-500 μm longa; sporangia fusco-nigra, ad 60 μm diam; columellae subglobosae, ad 40 x 35 μm; sporangiosporae angulatae vel breviter ellipsoideae, leves, ad 7 μm diam; chlamydosporae in mycelio aerio; zygosporae ignotae. Crescit et sporulat temperaturis inter 15 et 36°C.
Typus vivus et exsiccatus: CBS 427.87, isolatus a M.C. Joshi, Naini Tal, India.

Colonies on oatmeal agar at 30°C attaining a diameter of 9 cm within 4 days, at first white, soon becoming gray. Rhizoids simple, subhyaline; sporangiophores on stolons up to 200-500 μm in length and 10 μm wide, brownish, in groups of 1-9. Apophysate sporangia brownish black, up to 60(-75) μm diam. Columellae (sub)globose to subglobose-conical, brownish, up to 40 x 35 μm, rarely larger. Sporangiospores angular to broadly ellipsoidal, up to 6-8 μm, smooth-walled. Immature long-ellipsoidal sporangia were observed under all conditions of the study. Chlamydospores in the aerial mycelium. Zygospores unknown.

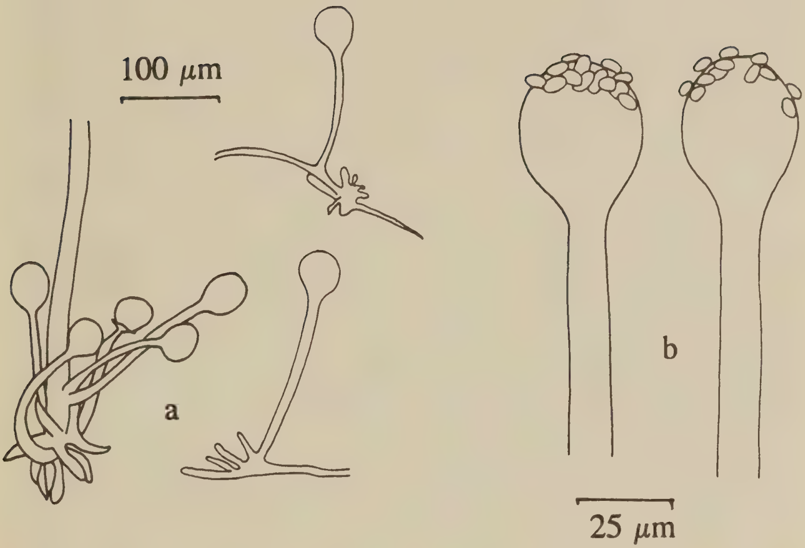

Fig. 5. *Rhizopus caespitosus* (CBS 427.87). Sporangiophores on stolons and opposite rhizoids, b. columellae.

Temperature requirements: Growth and sporulation between 15° and 36 C, slow at 15°C, optimum at 30-36°C. At 45-50°C growth occurs without sporulation.
Influence of medium: On Czapek agar colonies were thin, with few sporangiophores.

Material examined: CBS 427.87, isolated from unknown source by M.C. Joshi, Botany Department (D.S.B. Constituent College), Kumaum University, Naini Tal, India.

R. caespitosus has the general characteristics of the *R. microsporus* complex (Schipper & Stalpers, 1984) in which it is nearest to *Rh. microsporus* var. *microsporus*. It differs from this taxon in the production of sporangiophores in groups of up to 9, immature long ellipsoidal sporangia which occur under all culture conditions tested, smooth-walled sporangiospores and the ability to grow at 50°C. Matings with both mating types of *R. microsporus* var. *microsporus* were unsuccessful.

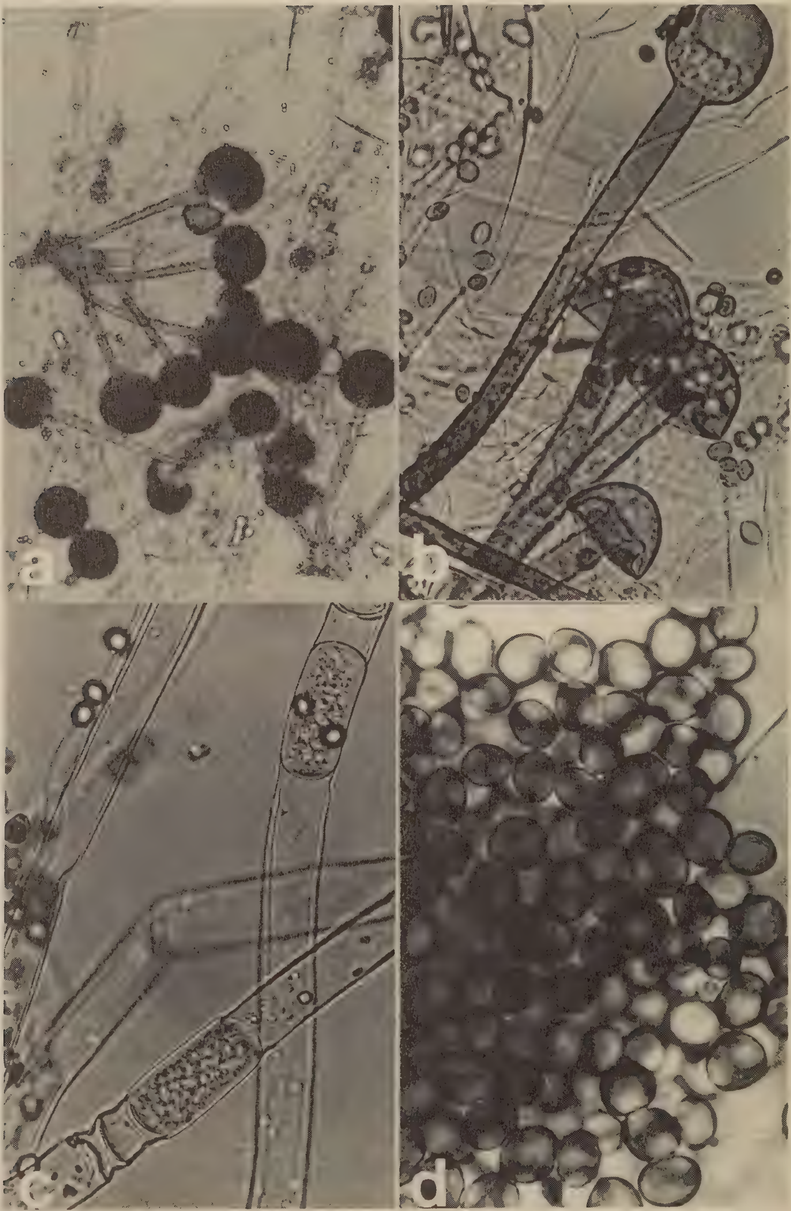
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Fig. 6. *Rhizopus caespitosus* a. Sporangiophores x 140, b. sporangiophores with columellae x 560, c. chlamydospores x 560, d. sporangiospores x 1400.

In the key given by Schipper and Stalpers (1984) the new species keys out ad 2: sporangiospores angular to broadly ellipsoidal, up to 8 μm, smooth-walled.

Mucor variosporus Schipper — Fig. 7.

The description of *M. variosporus* (Schipper, 1978) was based on a single isolate (CBS 837.70) obtained from rotten fruit of *Ficus*. Five strains were later obtained from P.C. Misra (Gorakhpur, U.P., India): CBS 650.78 = P.C.M. 615 and CBS 651.78 = P.C.M. 616, ex lizard dung, 1977; CBS 652.78 = P.C.M. 618 and CBS 653.78 = P.C.M. 620, ex shrew dung, 1978; CBS 654.78 = P.C.M. 621, ex owl pellet, 1978.

These isolates differ from the type by producing slightly narrower sporangiospores with more pointed ends. The size of sporangiospores are as follows:

CBS 837.70 (T): 5.5-13.5 x 3.5-8 μm;
CBS 650.78: 7-10 x 2.5-3 μm;
CBS 651.78: 5-10 x 2.5-3 μm;
CBS 652.78: 7-10 x 2.5-3 μm;
CBS 653.78: 5-7 x 2-3 μm;
CBS 654.78: 3.5-7.5 x 2-3 μm

At 36°C all the strains show some growth, but this is rather slow to restricted.

CBS 650.78 and 651.78 were received as mating partners and the most profuse yield of zygospores was obtained between these two. When grown on malt extract agar at 25°C, zygospores were formed throughout the colony at the line of contact.

Zygospores were black, up to 80 μm diam (including the stellate spines 10 μm in length) and they were borne between unequal suspensors. One suspensor is short while the other one is approximately globose, with or without reddish brown contents.

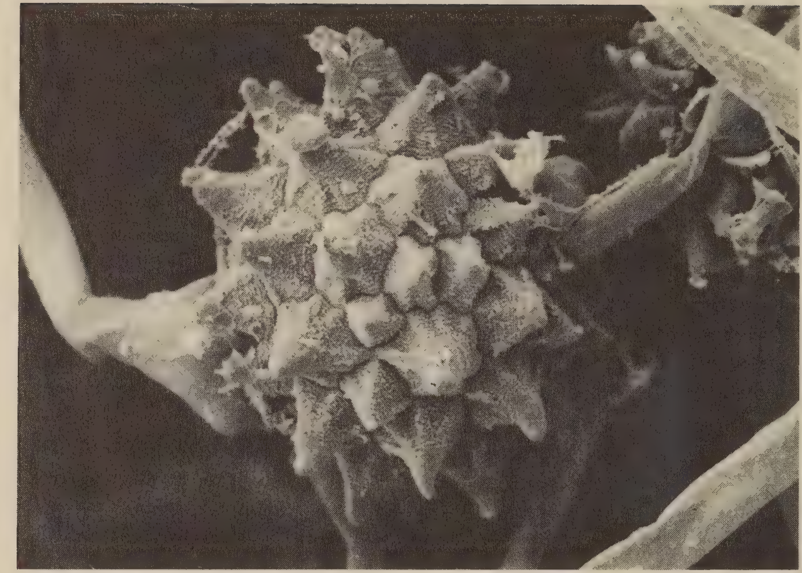


Fig. 7. Zygospore of *M. variosporus*, x 1400.

Matings of the type strain of the species CBS 837.70 (-) with CBS 651.78 resulted in the production of similar zygospores and suspensors, though fewer in number and mixed with some which were immature and reddish brown. Mating experiments between all available isolates revealed the following mating reactions:
(+): CBS 651.78; 652.78;
(-) : CBS 837.70; 650.78; 653.78; 654.78

Mucor faisalabadensis Mirza & al.

Mirza *et al*. (1979) described *M. faisalabadensis* based on a single homothallic isolate and stated that it belongs to *Mucor* section *Genevensis* Hesseltine. Our examination of the type culture CBS 661.86 showed, that it has sporangiophores which arise directly from the substrate, and apophysate pyriform sporangia. The zygospores are distinctly stellate and borne on unadorned suspensors. The apophysate pyriform sporangia are characteristic of *Absidia* spp. In common with species of *Absidia* subgenus *Mycocladus* Hesseltine & J.J. Ellis, it has unadorned suspensors and gradually widening sporangiophores which show a darker colouring just below the sporangia. In addition, giant cells in the substrate and temperature requirements for growth of 15-40(-45)°C are also typical of species of subgenus *Mycocladus*. However, *M. faisalabadensis* does not fit in *Absidia* because the sporangiophores arise directly from the substrate, while stolons and rhizoids are absent. In addition, the zygospores are not smooth-walled but distinctly stellate as seen in *Mucor* spp.

The temperature/growth relations differ from *Mucor*, where only few species grow and sporulate well at 40°C and slowly at 15°C, e.g. *Mucor indicus, M. prayagensis* and *M. variabilis*.

Since the taxon does not fit either in *Mucor* or *Absidia*, the following new genus is proposed.

PROTOMYCOCLADUS Schipper & Samson, gen. nov.

Sporangia pyriformia, apophysata; sporangiophora simplicia sympodialiter ramosa, ex hyphis submersis oriunda; stolones et rhizoidea absentia. Zygosporae ornamentatae, verrucae *Mucoris* modo stellatae; suspensores aequales haud ornamentati. Species thermotolerans.

Species typica *Mucor faisalabadensis* J.H. Mirza, S.M. Khan, Shamsad Begum & S. Shagufta.

Sporangia pyriform, apophysate, borne on simple sporangiophores which are sympodially branched, arising from the substrate; stolons and rhizoids absent; stellately ornamented zygospores borne between unadorned suspensors; thermotolerant.

Type species: *Mucor faisalabadensis* J.H. Mirza, S.M. Khan, Shamsad Begum & S. Shagufta

Protomycocladus faisalabadensis (Mirza & al.) Schipper & Samson, comb. nov. — Fig. 8-9.

Basionym: *Mucor faisalabadensis* J.H. Mirza, S.M. Khan, Shamsad Begum & S. Shagufta - Mucorales of Pakistan, Univ. Agric. Faisalabad Pakistan, p. 69. 1979.

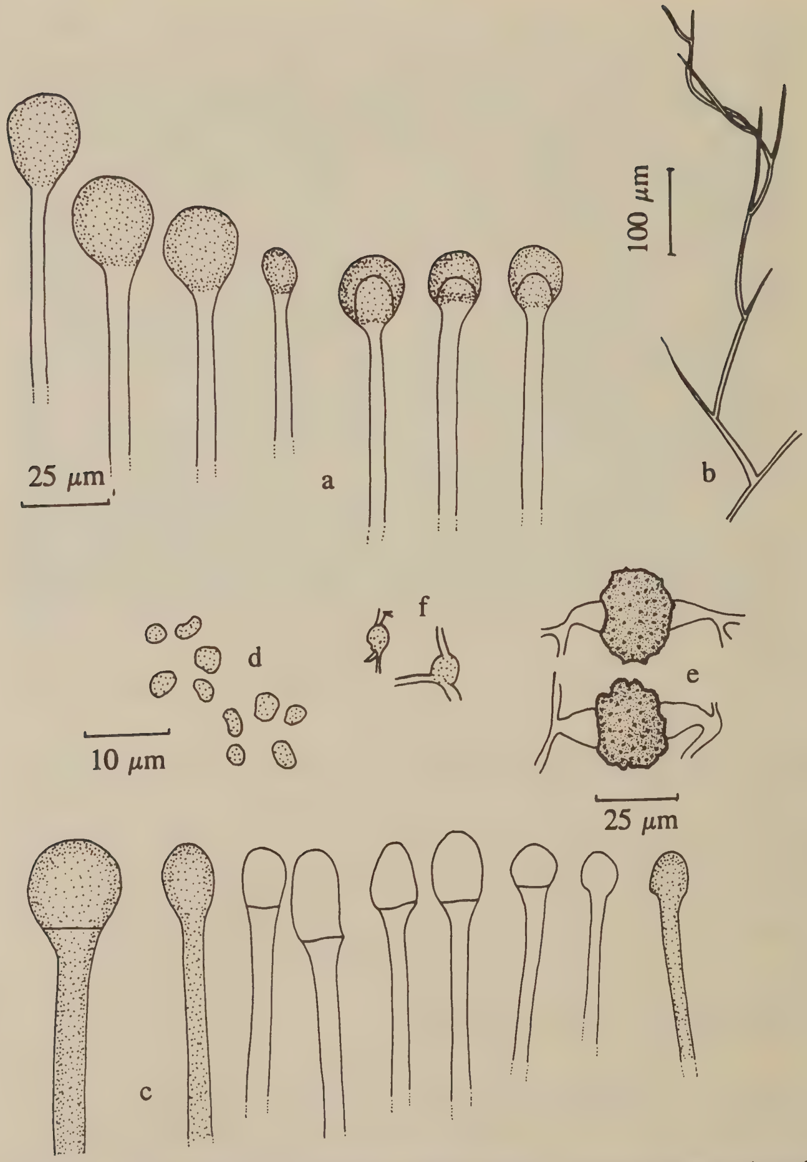
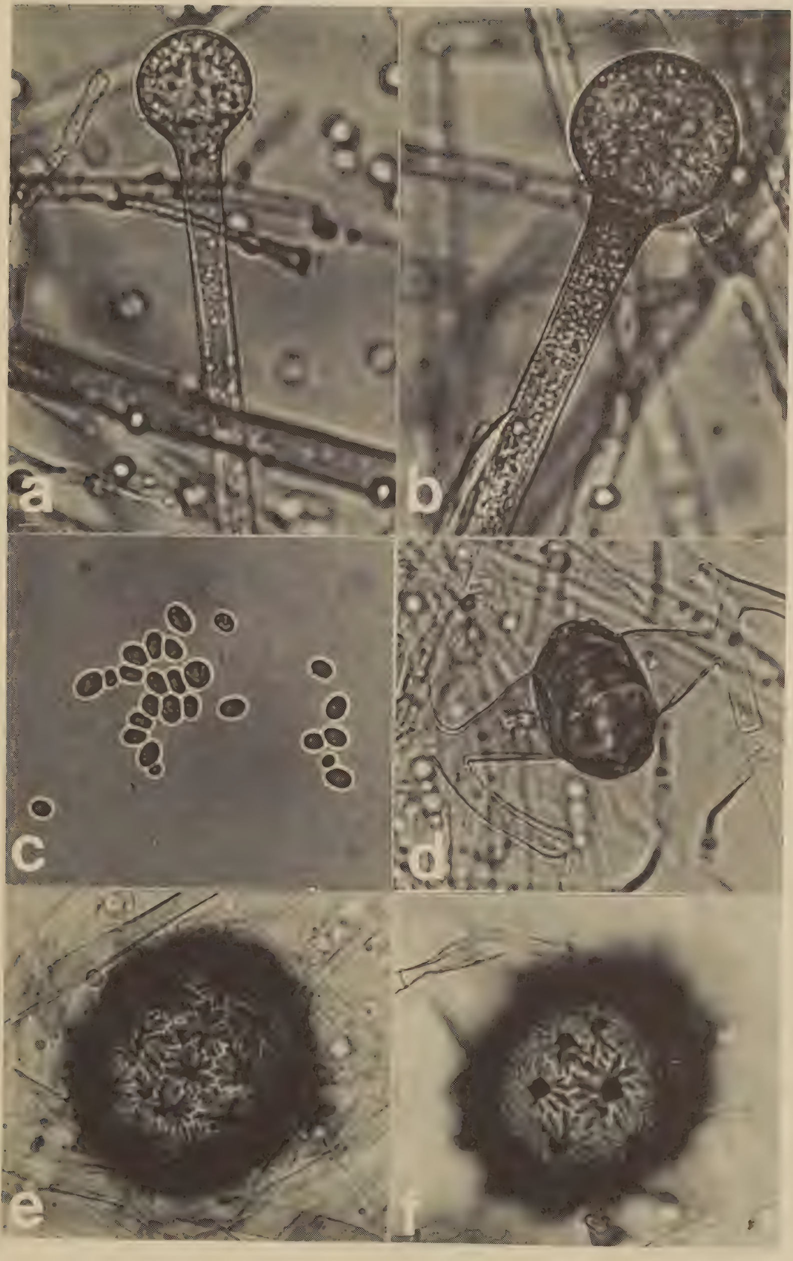


Fig. 8. *Protomycocladus faisalabadensis* (CBS 661.86). Young sporangia, b. branching patterns of sporangiophores, c. columellae, d. sporangiospores, e. zygospores, f. swollen substrate hyphae.

Fig. 9. *Protomycocladus faisalabadensis* (CBS 661.86). a-b. sporangiophores a. x 670 b. x 600, c. sporangiospores x 1500, d-f. zygospores x 600.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Colonies grown on malt extract agar at 25°C light brownish grey; sporangiophores arising from the substrate, unbranched or with (secondary) branching near the tip due either to restricted growth conditions (e.g. in a low dish) or to collapse of the slender stalks, which are approx. 7 μm diam, widening towards the apophysis, hyaline, darkening below the sporangia; sporangia apophysate pyriform, multispored, up to 75 μm diam, brownish, with deliquescent walls; columellae cylindrical-ellipsoidal, up to 50 x 35 μm; sporangiospores ellipsoidal, 3-6(-7.5) x 2.4-4(-5) μm. Zygospores homothallic, reddish brown to dark brown, mostly inside an exudate droplet, up to 80 μm diam, including the stellate projections up to 7 μm in length; suspensors opposite, straight, equal, conical, lacking appendages; substrate hyphae with prominent swellings.

Influence of temperature: between 15-30°C development increasing from very slow at 15°C to luxuriantly at 30°C. At 15°C sporangiospores were up to 4 x 8 μm, giant cells occurred in the substrate; at 33-36°C optimal growth, sporangia and zygospores present; at 40°C good growth and sporulation, no zygospores observed, at 45°C a sterile lobed colony was formed; at 50°C no growth.

Material examined: CBS 661.86, ex type culture (P291) received from J.H. Mirza isolated from rodent dung, Faisalabad, Pakistan.

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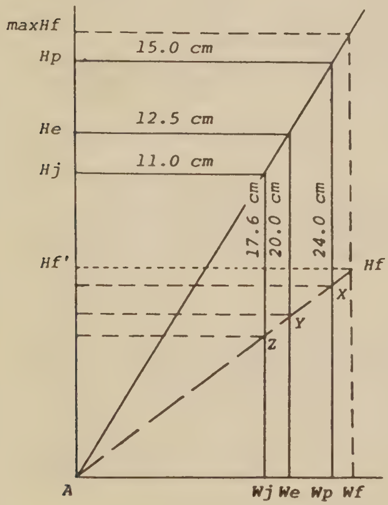

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Page 542	line 24	*for* (1979)	*read* (1977)
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